FOOD HABITS AND DIET OVERLAP

OF VARIOUS EASTERN BERING SEA FISHES

by

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ABSTRACT

"The food habits and diet overlap of 25 fish species in the eastern Bering Sea were studied. Most of the data were derived from quantitative shipboard stomach scans performed by U.S. fishery observers aboard foreign fishing vessels. Detailed laboratory analysis of Pacific halibut (Hippoglossus stenolepis), Alaska plaice (Pleuronectes quadrituberculatus) and sablefish (Anoplopoma fimbria) stomachs was also performed and is included in this report. Important baseline food habits data are presented for some species that have not been well-studied in the eastern Bering Sea, such as the cottids and zoarcids.

Food overlap was generally moderate to low but high overlaps did occur among closely related species or those which occurred in similar habitats. Juvenile walleye pollock (Theragra chalcogramma) was the major commercial fish species consumed; it comprised more than 20% by weight of the diet of several of the piscivores studied. The consumption of Tanner crabs (Chionoecetes bairdi, C. opilio) by cottids warrants further study given their relatively large contribution to the diet of these predators.

CONTENTS

INTRODUCTION

The main purpose of the Fish Food Habits Program in the Resource Ecology and Fisheries Management Division of the Northwest and Alaska Fisheries Center (NWAFC) is to study the food habits of key fish species in the eastern Bering Sea. Key fish species are defined as those species that consume commercially important fishes or crabs and that form a major portion of the groundfish biomass. Since predation accounts for the major part of natural mortality for young fish and crab, it is important to estimate the magnitude of predation losses from commercially important populations to improve population models used in fishery management. Key fish species that are routinely collected and subjected to detailed laboratory analysis of stomach contents are walleye pollock (*Theragra chalcogramma*), Pacific cod (*Gadus macrocephalus*), Greenland turbot (*Reinhardtius hippoglossoides*), arrowtooth flounder (*Atheresthes stomias*), yellowfin sole (*Limanda aspera*), and flathead sole (*Hippoglossoides elassodon*) (Livingston et al. 1986).

A secondary program objective is to obtain food habits information on less abundant fish species using quantitative shipboard scans. Shipboard scanning of stomach contents provides a quick, low-cost method of obtaining approximate total stomach volume and gross evaluation of prey taxonomic categories. This method is particularly useful for obtaining baseline information on fish food habits and determining whether more detailed examination of stomach contents is warranted, particularly when the prey are either commercially important or important to the ecosystem.

The purpose- of this report is to summarize the quantitative stomach scan data obtained thus far on various fishes in the eastern Bering Sea. This will provide: 1) baseline information on the food habits of species that have not been previously studied, 2) additional information on food habits of species that have not been studied in the eastern Bering Sea, and 3) collaborative information on species that have already been studied to some extent in the eastern Bering Sea. The results will also be used to guide the direction of future food habits research on these infrequently studied fish. For instance, fishes with diets similar to the dominant species should be identified because, in the event of a decrease in abundance of dominant predators by fishing or other factors, they may be able to fill the vacated trophic niche.

METHODS

Sample Collection and Processing

Stomachs of various fish species were examined at sea during 1985 and 1986 by U.S. fishery observers aboard foreign fishing vessels and by U.S. scientists aboard research vessels participating in NWAFC resource assessment surveys in the eastern Bering Sea. The locations of stations where the stomach scans used in this study were taken are shown in Figure 1. In addition, results from stomachs of Pacific halibut (Hippoglossus stenolepis), sablefish (Anoplopoma fimbria), and Alaska plaice (Pleuronectes quadrituberculatus) that were collected and subjected to detailed laboratory analysis are included in this report. The number of samples collected by season and year for both the scan and laboratory analysis are summarized in the Appendix table.

In the field, individual fish were first checked for signs of regurgitation (i.e., food items in the mouth or gill rakers or a flaccid stomach), and were discarded if any such signs were noted. The following sampling protocol was used for handling fish that had regurgitated, to insure that the true proportion of feeding to nonfeeding fish was maintained in the retained sample of stomachs. Since a fish that has regurgitated is assumed to be feeding fish, the next stomach to be retained after discarding a fish that has regurgitated should be one with contents. Thus, if a fish with an empty (nonregurgitated) stomach was encountered immediately after discarding a fish that had regurgitated, then this fish was also discarded.

Once a fish was selected for a quantitative field scan, the stomach was excised and the volume of the stomach contents was determined by the water displacement method by emptying the stomach contents into a graduated cylinder or beaker containing a known amount of water. The difference between the initial water level and the new water level after the stomach contents were added was the stomach volume. Volume can later be converted to weight by assuming 1 ml of volume displaced is equal to 1 g. The contents were then emptied onto a petri dish or tray, prey were separated into the finest taxonomic categories possible, and the volume (expressed as a percentage of the total) was visually estimated and recorded for each prey category. Numbers of individuals in a prey category were also counted, if practical. -Measurements for fish (standard length) and crab (carapace width) prey were taken if an item. was whole. Station information and predator fork length, sex, and spawning condition were recorded.

Fish stomachs selected for detailed laboratory analysis were chosen as described above. After the stomach was excised, it was placed into an individual cloth bag with a specimen label recording station information and predator fork length, sex, and spawning condition. The samples were then preserved in a 10% buffered%, formalin solution and sent to Seattle for analysis. Stomachs were analyzed individually in the laboratory. Prey items were identified to the lowest practical taxonomic level and the number of each prey taxon was recorded. Damp weight was calculated to the nearest milligram. Standard length measurements of fish and carapace widths of crab prey were taken when whole prey were available.

For both quantitative shipboard scans and detailed laboratory analysis, the prey category "fishery discards" was used if the ingested item was obviously consumed dead upon its return to the sea after being processed aboard a ship (i.e., a consumed fish which had had its head sliced off with a clean diagonal cut). Due to the difficulties involved in shipboard identification of taxonomic categories, particularly by inexperienced biologists, some prey taxa may have been misidentified. However, the identification of the commercially important fishes and crabs to the species level can be considered reasonably accurate.

Data Analysis

For both quantitative shipboard scan data and detailed laboratory analysis data, percent frequency of occurrence and percentage of total stomach content weight were calculated for each prey item for a particular fish predator. Since accurate prey counts were made only for stomachs analyzed in the laboratory, percentage of total prey number was summarized only for those stomachs.

Odum's (1959) diversity index (D) by weight was calculated for each predator using the following formula:

$$D = \text{number of species consumed}/\log^{10}(\text{total prey weight}). \qquad (1)$$

This index can be used to compare the relative number of prey species consumed 'between predators. Fish with high values of D relative to other species would be considered to have a more diverse diet.

Based on a review of dietary overlap measures (Cailliet and Barry 1979; Linton et al. 1981), Schoener's (1970) index was chosen because it was found to be accurate for most of the potential overlap range (Linton et al. 1981).

Schoener's index, C_{xy}, is calculated as:

$$C_{xy} = 1.0 - 0.5 \Sigma \left|P_{xi} - P_{yi}\right|, \quad (2)$$

where P_{xi} and P^{yi} are the estimated proportions by weight of prey i in the diets of species x and y, respectively. The index ranges from 0, which indicates no dietary overlap, to a maximum overlap of 1, when all prey items are found in equal proportions.

RESULTS AND DISCUSSION

General Food Habits

Quantitative shipboard scans were done on 2,856 stomachs from 25 species (Appendix). Of these, 2,242 stomachs contained food and the contents of these will be discussed in the following sections by species. The majority of the stomachs examined were collected during summer and fall seasons. A high percentage of those examined from the winter and spring were empty (Appendix).

Results of analyses of 390 stomachs containing food from the three species (A. fimbria, P. quadrituberculatus, and H. stenolepis) that were analyzed in detail in the laboratory are presented separately but are compared to the scan results when appropriate.

Bathyraja parmifera

A wide diversity of prey was found in the stomachs of the nine Alaska skate examined in shipboard scans (Table 1). Pelagic and demersal fishes and benthic crustaceans made up the majority of the diet in the eight stomachs which contained food. Tanner crabs (Chionoecetes bairdi, C. opilio), walleye pollock, and unidentified flatfishes dominated the diet by weight. Since this species was one of the largest that we examined (total lengths up to 95 cm), the prey found were mostly adult specimens of pollock (31-46 cm) and large Tanner crabs (carapace widths up to 43 mm).

Little is known about the food habits of Alaska skate. Mito (1974) examined 85 B. parmifera stomachs and found that smaller individuals feed predominantly on benthic decapod crustaceans (Tanner crabs and crangonid shrimp), whereas larger skates fed mainly on walleye pollock. These prey items were consistent with what we found in the limited number of Alaska skate we examined.

Clupea harengus pallasi

The diet of Pacific herring was dominated by pelagic microcrustaceans, mainly euphausiids and copeptis, although a few soft-bodied pelagic polychaetes and larvaceans were also consumed (Table 2). Because of the small size and poor condition of the prey found, it was difficult to identify the stomach contents beyond major taxonomic categories. Therefore, few prey taxa were represented despite the relatively large number (247) of stomachs examined.,

The inshore food habits of C. harengus pallasi have been studied throughout its range (see references in Livingston and Goiney (1983)) but the offshore food habits are not as well known. In an extensive study of eastern Bering Sea herring, Rumyantsev and Darda (1970) found euphausiids were by far the most frequently occurring prey item, followed by larval fish, calanoid copepods, and gammarid amphipods. In more temperate waters of the North Pacific, Wailes (1936) found that adults of this species consumed mostly euphausiids and copepods off British Columbia; Brodeur et al. (1987) found euphausiids, copepods, hyperiid amphipods, and decapod larvae to be important off Washington and Oregon. The similarity in herring diets among these studies and with our own results suggests that this species feeds mainly on pelagic microcrustaceans but will consume other small prey when available.

Gadus macrocephalus

The 75 Pacific cod stomachs examined in this study were collected from a limited midshelf area north of the Alaska Peninsula (Fig. 2). This species consumed primarily pelagic and demersal fishes and secondarily decapod crustaceans (Table 3). Over one-third of the diet by weight was walleye pollock (length range 60-460 mm). One stomach alone contained 15 juvenile pollock. Pleuronectids were not commonly consumed but made up about 25% of the total diet by weight. Two incidences of cannibalism were found, but young Pacific cod contributed only about 6%' of the biomass consumed by adults. Unidentified shrimp were the most common invertebrate prey, although hermit (Pagurus spp.) and Tanner crabs were important by weight. The diversity of prey identified from cod stomachs was fairly high compared with the other species scanned.

Numerous studies have examined the feeding habits of this commercially important predator- in the North Pacific Ocean (Mito 1974; Feder 1977; Jewett 1978; Westrheim and Harling 1983; Albers and Anderson 1985; Livingston et al. 1986; Wakabayashi 1986). These researchers have found that G. macrocephalus exhibits much diversity in its diet with the main foods being fishes (mainly pollock, herring, capelin (Mallotus villosus) and flatfishes), pandalid shrimps, Tanner crabs, and euphausiids. Our results for the eastern Bering Sea reiterate the trophic importance of this species in the consumption of many commercially important prey.

Bothrocara brunneum

Of the 15 twoline eelpouts examined, the stomachs of slightly more than one-half contained food. Few prey items were identified from this relatively deepwater zoarcid. Gammarid amphipods, euphausiids, and unidentified crustaceans were the only prey found in the stomachs (Table 4). Fitch and Lavenberg (1968) characterized this species as one that feeds on a variety of bottom-dwelling organisms off California; however, food habits studies have not previously been conducted for this species in the Bering Sea.

Lycodes brevipes

Shortfin eelpout in our collections consumed both benthic and pelagic prey, although the vast majority of the prey biomass (almost 90%) was made up of brittle stars (Table 5). Benthic polychaetes and pelagic euphausiids and copepods were of minor importance in some stomachs. A previous study on the feeding of this species in the Bering Sea and Gulf of Alaska (Smith et al. 1978) had shown that polychaetes, euphausiids, and decapod crustaceans were the main-food items consumed, but did not find brittle stars represented in the diet.

Lycodes palearis

Wattled eelpout consumed a varied diet consisting mainly of crustaceans and polychaetes (Table 6). Over one-third of the diet consisted of the two species of Tanner crabs (C. opilio and C. bairdi). Gammarid amphipods and polychaete worms were the most frequently occurring prey items. The only fish found in the limited number of stomachs examined was an unidentified eelpout. Our findings were similar to those of Mito (1974) who found that L. palearis consumed mostly gammarid amphipods, crangonid shrimp, and Tanner crabs in the eastern Bering Sea.

Coryphaenoides pectoralis

A wide variety of prey were found in the 20 pectoral rattail stomachs containing food. Although fish made up over 80% of the total weight of prey consumed, shrimp and cephalopods were common prey in some stomachs (Table 7). Several juvenile eelpouts were the only fish that were identified. The occurrence of carcasses discarded from the fishery attests to the opportunistic feeding behavior of this deepwater species. Novikov (1970) also found a wide variety of prey in stomachs of this species in the Bering Sea, of which mesopelagic fishes, squids, and shrimp were the dominant components.

Sebastes alutus

Only 38% of the Pacific Ocean perch stomachs examined contained food, which may be due in part to stomach eversion of the fish brought up from deep water. Euphausiids and shrimp dominated the diet and showed the same relative frequency of occurrence and weight proportions (Table 8). Walleye pollock and flatfish were also important by weight in the stomachs examined.

The food habits of this wide-ranging species have been analyzed in a number of previous studies (Lyubimova 1963; Skalkin 1964; Mito 1974; Somerton et al. 1978; Brodeur and Pearcy 1984). These reseachers found that smaller *S. alutus* tend. to feed mainly on copepods and euphausiids, whereas larger individuals feed on euphausiids, shrimps, and, to a lesser degree, fishes. A high percentage of everted stomachs was a common feature of many of these studies.

Sebastes polyspinis

The stomach contents of northern rockfish were relatively well digested, hence few prey items were found and much of the contents was unidentifiable (Table 9). Unidentified fishes and euphausiids were the most important prey, while squid remains and amphipods were of minor importance. Previous studies (Skalkin 1964; Mito 1974) have shown euphausiids, fishes, copepods, chaetognaths, crabs, and shrimp to be important components of the diet, suggesting that this species may be a generalist feeder.

Pleurogrammus monopterygius

Atka mackerel in this study had generally well-digested stomach contents. They were found to prey mostly on nektonic and zooplanktonic taxa (Table 10). Juvenile walleye pollock (<100 mm) were the dominant prey by weight and occurrence. A few Atka mackerel stomachs contained in excess of 10 pollock juveniles each. Euphausiids were the only other major prey item and the overall prey diversity was low. In some limited studies on the food of P. monopterygius conducted previously, Mito (1974) found euphausiids and walleye pollock to be the main foods in the Bering Sea and Feder (1979) found Pacific sandlance (Ammodytes hexapterus) and euphausiids to be important food on the Kodiak shelf.

Anoplopoma fimbria

The diet of sablefish was quite broad based on both detailed laboratory analysis and shipboard scans. Most stomachs examined in detail contained food, much of which was in relatively good condition. Euphausiids and one species of mysid (Holmesiella anomala) were the most numerous prey taxa found (Table 11), although the mysid species occurred only in one stomach. Fishes were the dominant prey by weight and were the only taxa that made up more than 1% of the total weight. Gadid fishes (mostly walleye pollock) accounted for about one-half of the total weight consumed.

A larger number of sablefish stomachs were examined at sea and were collected at stations along the outer shelf region and along the outer Alaska Peninsula (Fig. 3). The foods determined by this method were similar to those found in the laboratory method, with a few minor differences. Cephalopods were more important by weight in the scan stomachs, although the relative proportions of the identified fish prey were about the same (Table 12). The diversity of the diet of sablefish was high in both methods (scan D = 7.34 and lab D = 8.17) of stomach analysis. The food of sablefish has. been well documented in both the Bering Sea and elsewhere. Shubnikov (1963) found a wide variety of prey consumed by Bering Sea sablefish, especially actinaria, pandalid shrimp, and ophiuroids. Mito (1974) found walleye pollock to be the dominant food of eastern Bering Sea sablefish, although pandalid shrimp and other fish were also important. In the most complete study to date, Sasaki (1985) found fishes and echiuroids to be the most important foods of small (<40 cm fork length (FL)) sablefish; fishes, cephalopods, and shrimps were most important for larger individuals. These authors found much geographic variability in sablefish diets, which suggests an opportunistic feeding mode for this species.

Hemilepidotus hemilepidotus

Benthic crustaceans dominated the diet of red Irish lord in our sampling from the Bering Sea (Table 13). Most of the stomachs contained at least one hermit crab and this prey taxa alone comprised three-quarters of the total weight consumed. Tanner crabs (Chionoecetes spp.) were the next most important prey taxa by occurrence and by weight. Fishes made a relatively minor contribution to the total diet, and an overall low diversity of prey was found in the stomachs. We are not aware of any previous detailed studies of the food habits of this species in the Bering Sea.

Hemilepidotus jordani

Most of the collections of yellow Irish lord were taken from the middle or outer shelf region east of the Pribilof Islands (Fig. 4). A wide diversity of prey items was found in the stomach of this species with representatives from most of the major prey categories (Table 14). Pagurid crabs, Tanner crabs, and unidentified fishes were the most common taxa encountered in the stomachs and were important on a weight basis. Mollusks and echinoderms also contributed substantially to the diet in some instances. Walleye pollock and Atka mackerel were the major fish prey identified.

The food of H. jordani has been examined from both the Bering Sea and Gulf of Alaska. Mito (1974) found walleye pollock and Tanner crabs to be the main foods in the Bering Sea, with a minor contribution to the diet coming from polychaetes, shrimps, and other crabs. Majid crabs, gammarid amphipods, and mollusks were the dominant prey of this species on the Kodiak shelf (Jewett and Powell 1979). Similar to our results, Wakabayashi (1986) found brachyuran and anomuran crabs and, to a lesser extent, amphipods and fishes, to be the major prey of this species in the Bering Sea.

Hemitripterus bolini

Teleost fishes were the main prey items consumed by bigmouth sculpin in our sampling (Table 15). Walleye pollock dominated the diet, constituting greater than 71% of the total weight of stomach contents. Because of the large size (mean SL = 38.6 cm, range = 23 to 46 cm) of pollock consumed, relatively few prey made up the bulk of the stomach contents. Pacific herring, flathead sole, and eelpouts were of minor importance to the diet. Invertebrates were relatively unimportant in the diet of this species. Other studies on the food habits of this species in the Bering Sea (Mito 1974, Wakabayashi 1986) attest to the piscivorous habits of this species. Walleye pollock, eelpouts, and flatfishes were the main fish prey found by these authors.

Myoxocephalus jaok

Our collections of plain sculpins came entirely from the mid-shelf region of the Bering Sea (Fig. 5). No single prey item dominated the diet, although decapods and fishes were the dominant prey categories (Table 16). A wide range of sizes (carapace widths. from 9 to 45 mm) of C. opilio, the most important prey, was consumed. Hermit crabs, lyre crabs (Hyas spp.), and crangonid shrimp were other decapods commonly consumed. Several species of flatfishes, walleye pollock, and Pacific sand lance were relatively important on a weight basis. These results were similar to those found by Wakabayashi (1986). This author, however, found smelts (probably capelin) were the most important food by weight overall; whereas, this prey species was relatively unimportant in our study.

Myoxocephalus polyacanthocephalus

Great sculpin were collected over much of the mid-shelf area of the Bering Sea (Fig. 6). This species had a prey spectrum similar to that of its congener. M. jaok. in that decapods and fishes dominated the diet. Tanner crabs (mainly C. opilio) were the most common prey and made up almost one-half the biomass of prey consumed (Table 17). Walleye pollock were the next most important prey by weight. A wide range of pollock lengths (l-43 cm SL)) were consumed by this predator. Other important prey were yellowfin sole, rock sole (Lepidopsetta bilineata), and unidentified fishes. Prey diversity was relatively high overall. The importance of C. opilio and walleye pollock to the diet of this species in the Bering Sea has been shown by Mito (1974) and Wakabayashi (1986).

Agonus acipenserinus

The sturgeon poacher stomach contents examined in this study were generally in poor condition; therefore, few prey taxa were identified in the limited number of stomachs examined (Table 18). Gammarid and other unidentified amphipods were the most important prey consumed. Unidentified decapods were the only other prey taxa of any importance found in the stomachs of this species. The food habits of this species have not previously been examined for the eastern Bering Sea.

Trichodon trichodon

Relatively few prey items were found in the stomachs of Pacific sandfish (Table 19), although there was a great range of prey sizes from copepods a few millimeters long to walleye pollock up to 10 cm long. Fishes were the most important prey but none of these were identifiable with the exception of the pollock. A previous study on the food of this species from Cook Inlet in the Gulf of Alaska (Rogers et al. 1979) found small fishes to be the most important food item with euphausiids and brachyuran larvae of minor importance.

Glyptocephalus zachirus

Rex sole stomachs were collected from a limited number of stations, mostly at the shelf edge (Fig. 7). Although several major prey categories were represented in the diet, few prey were identified with much taxonomic resolution. Three prey categories, polychaetes, gammarid amphipods, and shrimp, dominated the diet by frequency of occurrence and weight (Table 20). Euphausiids and echiurids were of secondary importance.

Previous studies on the feeding habits of this species have shown results similar to our own. Mito (1974) and Kravitz et al. (1976) found the main foods of 5. zachirus were polychaetes and gammarid amphipods in the Bering

Sea and off the coast of Oregon, respectively. Smith et al. (1978) also found Tanner crabs to be important prey items in the Gulf of Alaska.

Hippoglossoides elassodon

All our collections of flathead sole were from the outer shelf and north of the Alaska Peninsula (Fig. 8). Based on our stomach samples, H. elassodon consumed a wide variety of prey items from several major taxonomic categories, both benthic and pelagic (Table 21). Echiurids, followed by polychaetes, euphausiids, and ophiuroids, were, the main prey items consumed. Prey of a wide range of sizes were consumed, from small chaetognaths to a walleye pollock measuring 12 cm in standard length.

Our results differ somewhat from the previously published findings for this species in the Bering Sea. Several of these studies (Skalkin 1963; Mineva 1964; Mito 1974) found that H. elassodon preyed mostly on ophiuroids and shrimp. Smith et al. (1978) also found mysids and walleye pollock to be major food items, especially during autumn. More recent studies (Livingston et al. 1986; Wakabayashi 19861 showed fishes to be important prey for larger flathead sole. Neither echiurids nor polychaetes were found to be important by these studies which may be a function of the time or location of our sampling.

Lepidopsetta bilineata

The majority of rock sole stomach collections came from the mid-shelf region of the Bering Sea, although some inshore collections north of Unimak Island were examined (Fig. 9). A high percentage (41.6%) of the stomachs examined were empty. This species consumed a wide variety of prey, but polychaetes generally dominated the diet, occurring in over one-half the stomachs and comprising more than 40% of the total weight consumed (Table 22).

Although some large prey were consumed (walleye pollock, king (Lithodes and Paralithodes spp.) and Tanner crabs), the majority of the diet consisted of small pelagic and benthic prey such as polychaetes, echiurids, shrimp, bivalves, and ophiuroids.

Many of these same prey items were found in other studies of L. bilineata food habits from the Bering Sea (Skalkin 1963; Mito 1974; Smith et al. 1978). Wakabayshi (1986) also found amphipods and sand lance to be important prey. Smith et al. (1978) found a high percentage (48%) of empty stomachs in their study.

Limanda proboscidea

The diet of longhead dab was dominated by polychaetes in the limited number of stomachs examined. Polychaetes occurred in all but two stomachs and made up-over three-fourths of the diet by weight (Table 23). Gammarid amphipods were the only other prey of importance. The food habits of L. proboscidea from the Bering Sea were also examined by Wakabayashi (1986), who found the same two major prey items but also found ascidians to be of moderate importance during 1 year of his sampling.

Platichthys stellatus

Starry flounder showed a high percentage (≈ 50%) of empty stomachs in our collections (Table 24). In contrast to the other species we examined, this species consumed mainly bivalves on both an occurrence and weight basis. Almost 96% of the total stomach content weight was bivalves. Polychaetes were the only other prey of importance identified from P. stellatus stomachs.

Bivalves and polychaetes have been previously reported among the food items of this species (Skalkin 1964; Jewett and Feder 1980; Wakabayashi 1986), although fish (especially sand lance) were usually more important prey than our sampling showed. Miller (1967) found that feeding by this species was seasonally variable and digestion fairly rapid, which may account for the high percentages of empty stomachs we found during the spring and summer months (Appendix).

Pleuronectes quadrituberculatus

The diet of Alaska plaice was relatively diverse, based on both detailed laboratory analysis (D = 37.19) and shipboard scans (D = 8.2). The majority of the stomachs examined in the laboratory contained food and were collected from a relatively confined area in the central part of the southeast Bering Sea (Fig. lOa). Gammarid amphipods were the most important prey numerically, comprising more than 80% of the total number in the detailed analysis (Table 25). However, this prey taxon was of much less importance gravimetrically, accounting for less than 10% of the total weight consumed. Polychaetes were commonly represented in the stomach and, due to the undigested condition of the stomach contents, a large number of taxa were identifiable. At least 16 families of polychaetes were identified and the most prominent was Nephtyidae which made up over one-third of the biomass consumed. Echiurids, gastropods, and bivalves frequently occurred in these stomachs but were relatively unimportant by number or weight. Foramanifera also occurred frequently, but were probably the result of inadvertent consumption while Alaska plaice ingested polychaetes in the sediments.

Shipboard scans of Alaska plaice stomachs were spread out over a broader area of the Bering Sea (Fig. l0b), which may have contributed to some differences in feeding habits between the two techniques we used. Polychaetes again were the most important prey by weight and also were the most frequently occurring prey. Bivalves were the next most important prey in terms of biomass.

The rest of the prey taxa, including gammarid amphipods, were found in less than 1% of the stomachs and made up less than 2% of the total weight consumed.

Our results were consistent with past studies (Skalkin 1963; Mineva 1964; Wakabayashi 1986) that showed polychaetes, bivalves, amphipods, and echiurids to be the dominant prey taken by P. quadrituberculatus in the Bering Sea. It appears that this species is fairly specific in its prey selection on a major taxonomic level but a variety of species are consumed within these categories.

Hippoglossus stenolepis

Collections of Pacific halibut stomachs came from two fairly confined areas in both the mid-shelf region and around the Pribilof Islands (Fig. 11a). This species tended to consume mostly larger nektonic and benthic prey, based on the detailed laboratory stomach analysis (Table 27). Pagurid and Tanner crabs (mostly 2. bairdi) were the most important invertebrate taxa represented in all three measures used. Fishes were dominant on a weight basis, however, contributing over 75% of the total biomass consumed. Walleye pollock made up about one-half of this total and was followed in importance by yellowfin sole, Pacific herring, Pacific sand lance and Pacific cod. Overall, a relatively diverse prey spectrum was utilized by Pacific halibut.

The diet of halibut as determined by shipboard stomach scans (Table 28) was similar to the diet revealed by laboratory analysis. Fishes, however, were even more important by weight in the limited number of stomachs scanned, comprising more than 95% of the total weight consumed. About one-half this weight total consisted of unidentified fishes. Pollock were less important in these stomachs; Pacific sand lance and flathead sole were relatively more important.

Because of the importance of this species commercially and ecologically, the feeding habits of Pacific halibut are fairly well known; The diet tends to be variable by predator size and sampling location but consists mainly of teleosts, crabs, shrimp, and mollusks (Novikov 1964; Mito 1974; Smith et al. 1978; Best and St. Pierre 1986; Wakabayashi 1986). A large number of fish species have been identified although walleye pollock, sand lance, sandfish, and pleuronectids were the main taxa consumed.

Diet Similarity Among Dominant Species

The utilization of prey in the major taxonomic categories by the more common predators (>60 stomachs containing food) was examined. These predators showed several distinct patterns of prey use by weight (Fig. 121, which may be related to habitat and functional feeding morphology. Pacific herring were unique in that they consumed almost exclusively small pelagic zooplankton. Pacific herring showed relatively little dietary overlap with the other species (Fig. 13). Pacific cod, Atka mackerel, and sablefish diverged slightly in their diet but generally consumed pelagic fishes (mainly gadids (Fig. 12)), which resulted in moderate overlap among these species (Fig. 13). The four cottid species (red Irish lord, yellow Irish lord, plain sculpin, and great sculpin) were more benthivorous, consuming crabs primarily and fishes secondarily (Fig. 12). Diet overlap among the cottids was variable although it was generally higher within this group than between the cottids and the other species (Fig. 13). Overlap was the highest within congener pairs and between the sculpins (Myoxocephalus spp.), Pacific cod, and sablefish. The four flatfish species consumed polychaetes to some degree but the other important prey varied depending on the predator (Fig. 12). Rex sole also consumed small crustaceans such as amphipods and shrimp, whereas a substantial porfion of the diet of Alaska plaice consisted of bivalve mollusks. Flathead and rock sole had similar prey utilization patterns consuming echiurids and echinoderms, along with other invertebrates and fishes. Diet overlap among these species was moderate to high with rock sole and Alaska plaice showing the highest overlap (Fig. 13). Overlap between the flatfishes and the other principal fishes was low.

Utilization of Key Prey Species

Predator consumption of commercially important prey species was studied in detail in order to elucidate the food web connections between commercial and noncommercial Bering Sea fishes. Four prey species that presently support commercial fisheries in the eastern Bering Sea were consumed: walleye pollock, yellowfin sole, and two species of Tanner crab (*Chionoecetes* spp.). Based on weight percentages of the total diet that were identified to the species level from the scan data (Table 29), walleye pollock were preyed upon by a wide variety of predators, to a major extent by some such as the bigmouth sculpin. Tanner crab species were consumed by many of the cottids but were generally of lesser importance than pollock to this assemblage of fishes (Table 29). Pollock and Tanner crabs have previously been found to be important components of the food web in this region (Livingston et al. 1986). Further study of the cottid diets is warranted given their relatively large biomass in the eastern Bering Sea (approximately 300,000 metric tons (t) according to Bakkala (1984)) and their dependence on the commercially important Tanner crab species as prey. Yellowfin sole did not make up a major part of the diet of any species and will not be considered further.

Data from the detailed laboratory analysis show sablefish and Pacific halibut to be more important predators on commercial species such as walleye pollock (44.5 and 38.0% of the total diet, respectively) than do the scan data. Yellowfin sole and both Tanner crabs were also present in the detailed Pacific halibut prey list but made up less than 10% of the total diet.

Information follows on the location where these prey species were consumed based on the scan data only, and on number and size distribution of prey found in stomachs.

Walleye pollock

Walleye pollock were identified in 100 of the 2,242 stomachs scanned (4.46%). Fish that consumed pollock contained an average of three pollock per stomach and up to 15 juveniles were found in a single predator stomach. Pollock were consumed at 38 stations mainly in the middle shelf region east of the Pribilof Islands (Fig. 14). Few were consumed in the northwest region of the shelf and along the shelf edge. The majority of pollock were consumed during the spring and summer months.

There was a substantial range in sizes of the 180 measurable pollock prey consumed. (Fig. 15) with a mean size of 11.6 cm SL). Skveral modes were evident in the size distribution with the most commonly consumed size class being small juveniles (SL <5 cm). There was a significant ($p < 0.01$) increase in the size of walleye pollock consumed with increasing predator length for all predators combined (Fig. 16). The regression of predator length on prey length, however, did not show a strong relationship between the two variables ($r^2 = 0.40$).

Chionoecetes opilio

This species was found in 134 stomachs (5.98% of total with food) scanned from 41 stations in the Bering Sea, making it the most frequently observed prey item in this study. Most C. opilio were consumed north and east of the Pribilof Islands in the mid-shelf region (Fig. 17). A mean of 2.7 crabs were consumed by each predator with a maximum of 12 juveniles in one stomach.

This species was consumed during all seasons but most were eaten during fall and winter months.

A relatively wide size range of C. opilio carapace widths were found in predator stomachs during this study (Fig. 18), with an overall mean carapace width of 31.3 mm. The majority of crabs consumed were 1-2 year olds. There was a significant ($p < 0.01$) positive relationship between the length of predators and the size of C. opilio consumed (Fig. 191, but the fit was not very good ($r^2 = 0.18$).

Chionoecetes bairdi

This species was identified in 42 stomachs (1.87%) from 20 stations in this study. The locations where C. bairdi were consumed were mostly in the middle shelf region (Fig. 20) but were further southeast than those for C. opilio. An average of 3.61 C. bairdi were found in the stomachs in which they occurred, with a maximum of 9 found in one stomach. They occurred most frequently in stomachs scanned during the fall and winter months.

The size distribution of measurable crabs was similar to that of C. opilio, again showing a predominance of the younger age classes (Fig. 21). The mean carapace width measured was 24.7 mm. Although there was a trend toward increasing size of C. bairdi consumed with increasing size of predator (Fig. 22), the relationship was not significant.

Adequacy of Sampling

Because of the opportunistic nature of stomach sampling, there may be some limitation to the randomness of both the locations and specimens sampled. Therefore, the collections included in this study may not be totally representative of all areas in the Bering Sea and size classes of fishes that may be found even when a large number of stomachs were examined. This may impose some restrictions on our ability to make comparisons with other studies that used a more systematic sampling scheme. This bias may be especially important for opportunistic fishes..

Another potential limitation to the scan data is that the identifications were made at sea under a number of different conditions and by many individuals, with varying levels of taxonomic expertise. Although an attempt was made to standardize the methodology and familiarize the observers with the main prey categories, some variation in prey identification was inevitable between cruises. However, based on similarities between the scan stomach contents and detailed laboratory analysis in this and past studies, we feel this variability is minor, especially for the major prey taxa and commercially utilized species.

SUMMARY

This paper contributes new information on the food habits, diet overlap, and utilization of key commercially important species by 25 important pelagic and demersal fishes of the eastern Bering Sea. The diets of most of the species included in this study have been previously examined from the North Pacific or Bering Sea (see review by Livingston and Goiney 1983), although only a limited number of studies are available that have examined more than a few species from the eastern Bering Sea at the same time. The findings of this study can be summarized as follows:

1) In shipboard scans, the diets of the 12 species with sample sizes greater than 60 stomachs with food showed much variation among species. Several feeding types were apparent based on major prey categories consumed and diet overlap values. Pacific herring were unique being the only species to consume mostly pelagic microcrustaceans. Several species (Pacific cod,

Atka mackerel, and sablefish) were primarily piscivores, whereas demersal cottids fed mainly on crabs. The flatfishes diet centered around benthic invertebrates such as polychaetes, bivalves, echiurids, and echinoderms.

2) Predation on several commercially important prey resources by this assemblage of fishes was examined in detail. Juvenile walleye pollock were major prey for several species and were consumed mainly during the spring and summer months in the middle shelf region. The two Tanner crab species were consumed by many of the same predator species during the fall and winter but were preyed upon in different areas of the shelf region. Consumption of Tanner crabs by cottids warrants further study, possibly through continued collection and detailed laboratory analysis of cottid stomach contents.

Table 1.--Food habits of Alaska skate, Bathyraja parmifera, determined from quantitative shipboard stomach scans in the eastern Bering Sea.

Prey name	Freq. occur.	%Freq. occur.	Total weight	%Total weight
Gammaridea (amphipod)	1	12.5	7.00	0.59
Pleocyemata Caridea (shrimp)	2	25.0	52.00	4.42
Eucarida Decapoda Natantia (shrimp)	2	25.0	16.25	1.38
Paguridae (hermit crab)	3	37.5	55.25	4.69
Chionoecetes sp. (Tanner crab)	1	12.5	93.50	7.94
Chionoecetes opilio (Tanner opilio)	2	25.0	147.75	12.55
Osteichthyes Teleostei (fish)	1	12.5	23.75	2.02
Theragra chalcogramma (walleye pollock)	2	25.0	411.00	34.92
Pleuronectiformes (flatfish)	2	25.0	270.50	22.98
Fishery discards	1	12.5	100.00	8.50

Total number of stomachs	9
Total with food	8
Total prey weight (g)	1177.0
Feeding diversity by weight	3.25

Table 2.--Food habits of Pacific herring, Clupea harengus pallasi, determined from quantitative shipboard stomach scans in the eastern Bering Sea.

Prey name	Freq. occur.	%Freq. occur.	Total weight	%Total weight
Polychaeta (worm)	5	2.0	7.63	0.63
Calanoida (copepod)	59	23.9	206.02	17.08
Gammaridea (amphipod)	2	0.8	1.75	0.15
Amphipoda Hyperiidea (amphipod)	20	8.1	27.62	2.29
Euphausiacea (euphausiid)	191	77.3	944.87	78.34
Pleocyemata Caridea (shrimp)	1	0.4	2.00	0.17
Larvacea Copelata	7	2.8	3.60	0.30
Unidentified organic material	15	6.1	12.60	1.04

Total number of stomachs	271
Total with food	247
Total prey weight (g)	1206.09
Feeding diversity by weight	2.59

Table 3 .--Food habits of Pacific cod, Gadus macrocephalus, determined from quantitative shipboard stomach scans in the eastern Bering Sea.

Prey name	Freq. occur.	%Freq. occur.	Total weight	%Total weight
Polychaeta (worm)	4	5.4	3.66	0.04
Gastropoda (snail)	8	10.8	52.27	0.54
Bivalvia (clam)	2	2.7	18.20	0.19
Amphipoda (amphipod)	2	2.7	1.80	0.02
Gammaridea (amphipod)	8	10.8	13.91	0.14
Amphipoda Hyperiidea (amphipod)	1	1.4	0.10	0.00
Euphausiacea (euphausiid)	2	2.7	1.02	0.01
Eucarida Decapoda Reptantia (crab)	13	17.6	136.40	1.40
Pleocyemata Caridea (shrimp)	8	10.8	16.00	0.16
Eucarida Decapoda Natantia (shrimp)	24	32.4	188.08	1.93
Paguridae (hermit crab)	16	21.6	889.25	9.11
Chionoecetes sp. (Tanner crab)	15	20.3	537.30	5.51
Chionoecetes bairdi (Tanner bairdi)	15	20.3	607.42	6.22
Erimacrus isenbeckii (Korean horse-hair crab)	1	1.4	5.00	0.05
Echiura (marine worm)	1	1.4	2.50	0.03
Echiuridae (marine worm)	2	2.7	9.50	0.10
Holothuroidea (sea cucumber)	1	1.4	5.00	0.05
Osteichthyes Teleostei (fish)	13	17.6	561.15	5.75
Gadus macrocephalus (Pacific cod)	2	2.7	585.00	5.99
Theragra chalcogramma (walleye pollock)	12	16.2	3417.80	35.02
Ammodytes hexapterus (Pacific sand lance)	7	9.5	80.72	0.83
Pleuronectidae (flatfish)	9	12.2	2108.20	21.60
Hippoglossoides elassodon (flathead sole)	1	1.4	297.00	3.04
Limanda aspera (yellowfin sole)	1	1.4	180.00	1.84
Unidentified organic material	8	10.8	42.12	0.43

Total number of stomachs	75
Total with food	74
Total prey weight (g)	9759.4
Feeding diversity by weight	6.27

Table 4.--Food habits of twoline eelpout, Bothrocara brunneum, determined from quantitative shipboard stomach scans in the eastern Bering Sea.

Prey name	Freq. occur.	%Freq. occur.	Total weight	%Total weight
Crustacea	4	50.0	2.10	31.82
Gammaridea (amphipod)	4	50.0	3.90	59.09
Euphausiacea (euphausiid)	2	25.0	0.60	9.09

Total number of stomachs	15
Total with food	8
Total prey weight (g)	6.6
Feeding diversity by weight	3.66

Table 5.--Food habits of shortfin eelpout, Lycodes brevipes, determined from quantitative shipboard stomach scans in the eastern Bering Sea.

Prey name	Freq. occur.	%Freq. occur.	Total weight	%Total weight
Polychaeta (worm)	5	31.3	2.25	3.74
Bivalvia (clam)	1	6.3	0.01	0.02
Calanoida (copepod)	3	18.8	1.50	2.50
Gammaridea (amphipod)	1	6.3	0.09	0.15
Euphausiacea (euphausiid)	2	12.5	1.98	3.29
Echiura (marine worm)	1	6.3	0.10	0.17
Ophiuroidae Ophiurida (brittle star)	7	43.8	53.67	89.30
Osteichthyes Teleostei (fish)	1	6.3	0.50	0.83

Total number of stomachs	24
Total with food	16
Total prey weight (g)	60.1
Feeding diversity by weight	4.50

Table 6.--Food habits of wattled eelpout, <u>Lycodes palearis</u>, determined from quantitative shipboard stomach scans in the eastern Bering Sea.

Prey name	Freq. occur.	%Freq. occur.	Total weight	%Total weight
Polychaeta (worm)	7	36.8	12.00	23.08
Gammaridea (amphipod)	7	36.8	8.75	16.83
Pleocyemata Caridea (shrimp)	1	5.3	2.00	3.85
Crangonidae (shrimp)	2	10.5	2.25	4.33
<u>Chionoecetes</u> <u>opilio</u> (Tanner crab)	2	10.5	6.75	12.98
<u>Chionoecetes</u> <u>bairdi</u> (Tanner crab)	2	10.5	12.00	23.08
<u>Echiurus</u> <u>echiurus</u> (marine worm)	3	15.8	1.75	3.37
Ophiuroidae Ophiurida (brittle star)	1	5.3	0.50	0.96
Zoarcidae (eelpout)	1	5.3	6.00	11.54

Total number of stomachs	28
Total with food	19
Total prey weight (g)	52.0
Feeding diversity by weight	5.25

Table 7.--Food habits of pectoral rattail, <u>Coryphaenoides pectoralis</u>, determined from quantitative shipboard stomach scans in the eastern Bering Sea.

Prey name	Freq. occur.	%Freq. occur.	Total weight	%Total weight
Aphroditidae (sea mouse)	1	5.0	1.01	0.11
Cephalopoda (squid and octopus)	1	5.0	1.00	0.11
Teuthoidea (squid)	1	5.0	10.00	1.08
Octopoda (octopus)	4	20.0	9.29	1.00
Gammaridea (amphipod)	1	5.0	2.25	0.24
Euphausiacea (euphausiid)	1	5.0	0.50	0.05
Pleocyemata Caridea (shrimp)	5	25.0	104.00	11.19
Eucarida Decapoda Natantia (shrimp)	6	30.0	22.20	2.39
Osteichthyes Teleostei (fish)	10	50.0	556.51	59.90
Non-gadoid fish remains	2	10.0	20.00	2.15
<u>Lycodes</u> sp. (eelpout)	2	10.0	176.25	18.97
Unidentified organic material	2	10.0	13.50	1.45
Fishery discards	1	5.0	12.50	1.35

Total number of stomachs	24
Total with food	20
Total prey weight (g)	928.99
Feeding diversity by weight	4.38

Table 8. --Food habits of Pacific Ocean perch, Sebastes alutus, determined from quantitative shipboard stomach scansin the eastern Bering Sea.

Prey name	Freq. occur.	%Freq. occur.	Total weight	%Total weight
Gammaridea (amphipod)	1	5.3	0.23	0.22
Euphausiacea (euphausiid)	9	47.4	46.95	45.14
Pleocyemata Caridea (shrimp)	6	31.6	38.77	37.28
Theragra chalcogramma (walleye pollock)	1	5.3	6.00	5.77
Pleuronectidae (flatfish)	1	5.3	8.00	7.69
Unidentified organic material	4	21.1	4.05	3.89

Total number of stomachs	50
Total with food	19
Total prey weight (g)	104.0
Feeding diversity by weight	2.98

Table 9. --Food habits of northern rockfish, Sebastes polyspinis, determined from quantitative shipboard stomach scans in the eastern Bering Sea.

Table 10.--Food habits of Atka mackerel, Pleurogrammus monopterygius, determined from quantitative shipboard stomach scans in the eastern Bering Sea.

Prey name	Freq. occur.	%Freq. occur.	Total weight	%Total weight
Cephalopoda (squid and octopus)	1	1.7	3.75	0.37
Octopoda (octopus)	1	1.7	1.00	0.10
Calanoida (copepod)	3	5.0	4.67	0.46
Amphipoda (amphipod)	5	8.3	30.75	3.04
Euphausiacea (euphausiid)	18	30.0	168.05	16.60
Osteichthyes Teleostei (fish)	4	6.7	66.45	6.56
Theragra chalcogramma (walleye pollock)	19	31.7	467.50	46.19
Unidentified organic material	38	63.3	270.03	26.68

Total number of stomachs	68
Total with food	60
Total prey weight (g)	1012.20
Feeding diversity by weight	2.66

Table Il.--Food habits of sablefish, Anoplopoma. fimbria, in the eastern Bering Sea determined from quantitative laboratory analysis.

Prey name	%Total number	%Freq. occur.	Total weight	%Total weight
Polychaeta (worm)	1.3	6.5	0.12	0.01
Teuthoidea (squid)	1.3	6.5	3.01	0.20
Teuthoidea Oegopsida (squid)	0.6	3.2	10.11	0.66
Gonatopsis sp. (squid)	1.6	3.2	3.93	0.26
Holmesiella anomala (mysid)	25.8	3.2	0.83	0.05
Gammaridea (amphipod)	0.6	3.2	0.02	0.00
Lysianassidae (amphipod)	0.6	3.2	0.01	0.00
Stenothoidae (amphipod)	0.6	3.2	0.41	0.03
Amphipoda Hyperiidea (amphipod)	0.6	3.2	0.01	0.00
Themisto sp. (amphipod)	1.3	6.5	0.02	0.00
Euphausiacea (euphausiid)	29.1	12.9	3.47	0.23
Eucarida Decapoda Reptantia (crab)	0.6	3.2	1.07	0.07
Pleocyemata Caridea (shrimp)	1.3	6.5	1.39	0.09
Hippolytidae (shrimp)	0.6	3.2	0.06	0.00
Eualus macrophthalma (shrimp)	7.3	3.2	2.00	0.13
Pandalidae (shrimp)	0.6	3.2	0.74	0.05
Crangonidae (shrimp)	0.6	3.2	0.36	0.02
Osteichthyes Teleostei (fish)	16.6	80.6	474.58	31.20
Clupea harengus pallasi (Pacific herring)	0.6	3.2	48.51	3.19
Gadidae (gadid fish)	1.3	6.5	69.90	4.60
Theragra chalcogramma (walleye pollock)	1.3	6.5	676.46	44.48
Zoarcidae (eelpout)	0.6	3.2	15.48	1.02
Lycodes sp. (eelpout)	0.6	3.2	32.06	2.11
Stichaeidae (prickleback)	0.6	3.2	4.60	0.30
Atheresthes stomias (arrowtooth flounder)	0.6	3.2	42.18	2.77
Fishery discards	3.3	12.9	129.60	8.52

Total number of stomachs	34
Total with food	31
Total prey count	151
Total prey weight (g)	1520.91
Feeding diversity by weight	8.17

Table 12.--Food habits of sablefish, *Anoplopoma fimbria*, determined from quantitative shipboard stomach scans in the eastern Bering Sea.

Prey name	Freq. occur.	%Freq. occur.	Total weight	%Total weight
Scyphozoa (jellyfish)	3	2.1	66.35	1.02
Anthozoa (anemone)	1	0.7	78.00	1.20
Polychaeta (worm)	2	1.4	0.46	0.01
Gastropoda (snail)	6	4.2	47.03	0.72
Cephalopoda (squid and octopus)	7	1.9	205.24	3.15
Teuthoidea (squid)	3	2.1	2.27	0.03
Teuthoidea Oegopsida (squid)	7	4.9	208.75	3.20
Octopoda (octopus)	1	0.7	7.00	0.11
Crustacea	2	1.4	0.35	0.01
Calanoida (copepod)	2	1.4	1.13	0.02
Amphipoda (amphipod)	1	0.7	18.75	0.29
Euphausiacea (euphausiid)	24	16.9	86.06	1.32
Decapoda (shrimp and crab)	2	1.4	15.00	0.23
Eucarida Decapoda Reptantia (crab)	4	2.8	38.95	0.60
Pleocyemata Caridea (shrimp)	8	5.6	128.93	1.98
Paguridae (hermit crab)	1	0.7	3.00	0.05
Paralithodes sp. (king crab)	1	0.7	7.50	0.12
Asteroidea (starfish)	3	2.1	3.60	0.06
Ophiuroidae Ophiurida (brittle star)	5	3.5	2.69	0.04
Osteichthyes Teleostei (fish)	93	65.5	2830.40	43.42
Clupea harengus pallasi (Pacific herring)	1	0.7	187.50	2.88
Gadidae (gadid fish)	1	0.7	46.20	0.71
Theragra chalcogramma (walleye pollock)	10	7.0	1695.00	26.00
Agonidae (poacher)	2	1.4	13.30	0.20
Pleuronectidae (flatfish)	1	0.7	50.00	0.77
Hippoglossoides elassodon (flathead sole)	1	0.7	75.00	1.15
Unidentified organic material	28	19.7	330.07	5.06
Fishery discards	4	2.8	370.00	5.68

Total number of stomachs	181
Total with food	142
Total prey weight (g)	6518.53
Feeding diversity by weight	7.34

Table 13. --Food habits of red Irish lord, *Hemilepidotus hemilepidotus*, determined from quantitative shipboard stomach scans in the eastern Bering Sea.

Prey name	Freq. occur.	%Freq. occur.	Total weight	%Total weight
Polychaeta (worm)	2	2.8	12.20	0.32
Gastropoda (snail)	7	9.9	70.15	1.87
Pleocyemata Caridea (shrimp)	2	2.8	4.70	0.13
Paguridae (hermit crab)	64	90.1	2822.15	75.10
Hyas sp. (lyre crab)	2	2.8	46.50	1.24
Chionoecetes sp. (Tanner crab)	9	12.7	256.80	6.83
Chionoecetes opilio (Tanner crab)	13	18.3	397.40	10.57
Chionoecetes bairdi (Tanner crab)	1	1.4	85.00	2.26
Osteichthyes Teleostei (fish)	4	5.6	54.10	1.44
Theragra chalcogramma (walleye pollock)	1	1.4	9.00	0.24

Total number of stomachs	72
Total with food	71
Total prey weight (g)	3758.0
Feeding diversity by weight	2.80

Table 14.--Food habits of yellow Irish lord, Hemilepidotus jordani, determined from quantitative shipboard stomach scans in the eastern Bering Sea.

Prey name	Freq. occur.	%Freq. occur.	Total weight	%Total weight
Hydrozoa (jellyfish)	2	0.7	1.00	0.01
Scyphozoa (jellyfish)	2	0.7	17.00	0.16
Anthozoa (anemome)	4	1.5	22.80	0.24
Nematoda (worm)	1	0.4	1.00	0.01
Polychaeta (worm)	20	7.3	51.72	0.38
Gastropoda (snail)	33	12.0	178.37	1.38
Bivalvia (clam)	8	2.9	25.09	0.26
Teuthoidea (squid)	7	2.6	99.57	1.03
Octopoda (octopus)	2	0.7	53.00	0.55
Calanoida (copepod)	8	2.9	16.40	0.17
Isopoda (isopod)	3	1.1	1.92	0.02
Flabellifera (isopod)	1	0.4	0.65	0.01
Amphipoda (amphipod)	9	3.3	11.22	0.12
Gammaridea (amphipod)	21	7.7	108.07	1.12
Amphipoda Hyperiidea (amphipod)	16	5.8	44.22	0.34
Themisto sp. (amphipod)	3	1.1	50.16	0.26
Caprellidea (amphipod)	1	0.4	0.33	0.00
Euphausiacea (euphausiid)	5	1.8	2.05	0.02
Eucarida Decapoda Reptantia (crab)	19	6.9	509.39	2.68
Pleocyemata Caridea (shrimp)	16	5.8	25.66	0.22
Crangon sp. (shrimp)	1	0.4	0.30	0.00
Eucarida Decapoda Natantia (shrimp)	2	0.7	2.40	0.01
Anomura (crab)	10	3.6	82.30	0.45
Paguridae (hermit crab)	100	36.5	2835.61	27.09
Pagurus sp. (hermit crab)	1	0.4	20.00	0.10
Decapoda Brachyura (crab)	3	1.1	12.66	0.13
Majidae (decorator crab)	1	0.4	3.00	0.03
Hyas sp. (lyre crab)	6	2.2	28.82	0.28
Hyas lyratus (lyre crab)	12	4.4	104.98	1.04
Hyas coarctatus (lyre crab)	2	0.7	23.00	0.20
Hyas coarctatus alutaceus (lyre crab)	1	0.4	2.59	0.03
Chionoecetes sp. (Tanner crab)	26	9.5	289.61	2.82
Chionoecetes opilio (Tanner crab)	22	8.0	483.22	4.81
Chionoecetes bairdi (Tanner crab)	28	10.2	388.67	3.13
Erimacrus isenbeckii (Korean horse-hair crab)	3	1.1	65.80	0.68
Pinnotheridae (pea crab)	1	0.4	2.50	0.03
Sipuncula (marine worm)	1	0.4	8.15	0.08
Echiura (marine worm)	3	1.1	20.75	0.13
Echinodermata	2	0.7	4.20	0.02
Asteroidea (starfish)	5	1.8	68.10	0.70
Ophiuroidae Ophiurida (brittle star)	24	8.8	126.85	1.31
Holothuroidea (sea cucumber)	4	1.5	70.44	0.36
Boltenia sp. (sea onion)	1	0.4	2.00	0.02
Osteichthyes Teleostei (fish)	42	15.3	2050.48	21.19
Non-gadoid fish remains	11	4.0	735.45	7.60

Table 14.--Continued.

Prey name	Freq. occur.	%Freq. occur.	Total weight	%Total weight
Theragra chalcogramma (walleye pollock)	7	2.6	298.30	2.90
Pleurogrammus monopterygius (Atka mackerel)	1	0.4	238.00	2.46
Agonidae (poacher)	1	0.4	5.00	0.05
Stichaeidae (prickleback)	1	0.4	1.85	0.02
Unidentified organic material	26	9.5	933.60	4.98
Unidentified eggs	1	0.4	48.75	0.50
Fishery discards	5	1.8	807.70	6.91
Overboard material (non-fishery)	2	0.7	64.77	0.67
Unidentified algae	3	1.1	2.70	0.03
Rocks	7	2.6	7.96	0.07
Unidentified material	2	0.7	34.38	0.18

Total number of stomachs	293
Total with food	274
Total prey weight (g)	13,680.46
Feeding diversity by weight	13.54

Table 15.--Food habits of bigmouth sculpin, *Hemitripterus bolini*, determined from quantitative shipboard stomach scans in the eastern Bering Sea.

Prey name	Freq. occur.	%Freq. occur.	Total weight	%Total weight
Bivalvia (clam)	4	11.1	2.95	0.02
Teuthoidea (squid)	1	2.8	65.00	0.45
Pleocyemata Caridea (shrimp)	4	11.1	39.55	0.27
Chionoecetes opilio (Tanner crab)	1	2.8	20.00	0.14
Osteichthyes Teleostei (fish)	11	30.6	1388.00	9.51
Clupea harengus pallasi (Pacific herring)	1	2.8	250.00	1.71
Gadidae (gadid fish)	3	8.3	647.00	4.43
Theragra chalcogramma (walleye pollock)	14	38.9	10412.50	71.33
Lycodes sp. (eelpout)	9	25.0	491.00	3.36
Hippoglossoides elassodon (flathead sole)	3	8.3	1050.00	7.19
Limanda aspera (yellowfin sole)	1	2.8	200.00	1.37
Unidentified organic material	3	8.3	27.00	0.18
Unidentified eggs	1	2.8	4.00	0.03

Total number of stomachs	52
Total with food	36
Total prey weight (g)	14,596.99
Feeding diversity by weight	3.12

Table 16.--Food habits of plain sculpin, Myoxocephalus jaok, determined from quantitative shipboard stomach scans in the eastern Bering Sea.

Prey name	Freq. occur.	%Freq. occur.	Total weight	%Total weight
Polychaeta (worm)	3	2.8	4.50	0.12
Bivalvia (clam)	1	0.9	1.80	0.05
Teuthoidea (squid)	1	0.9	1.05	0.03
Calanoida (copepod)	2	1.9	0.02	0.00
Pericarida Mysidacea Mysida (mysid)	2	1.9	0.90	0.02
Gammaridea (amphipod)	6	5.7	7.74	0.21
Euphausiacea (euphausiid)	4	3.8	3.19	0.08
Eucarida Decapoda Reptantia (crab)	2	1.9	2.20	0.06
Pleocyemata Caridea (shrimp)	13	12.3	71.46	1.90
Pandalidae (shrimp)	1	0.9	3.60	0.10
Crangonidae (shrimp)	1	0.9	5.00	0.13
Crangon dalli (shrimp)	15	14.2	62.72	1.67
Argis sp. (shrimp)	3	2.8	4.10	0.11
Paguridae (hermit crab)	7	6.6	145.20	3.86
Hyas sp. (lyre crab)	4	3.8	123.35	3.28
Chionoecetes sp. (Tanner crab)	1	0.9	18.75	0.50
Chionoecetes opilio (Tanner crab)	26	24.5	1153.95	30.70
Chionoecetes bairdi (Tanner crab)	1	0.9	8.40	0.22
Echiura (marine worm)	1	0.9	7.50	0.20
Ophiuroidae Ophiurida (brittle star)	1	0.9	1.60	0.04
Osteichthyes Teleostei (fish)	36	4.0	710.88	18.91
Mallotus villosus (capelin)	1	0.9	14.70	0.39
Theragra chalcogramma (walleye pollock)	9	8.5	140.55	3.74
Zoarcidae (eelpout)	2	1.9	64.25	1.71
Cottidae (sculpin)	2	1.9	60.90	1.62
Gymnocanthus galeatus (sculpin)	1	0.9	33.00	0.88
Agonidae (poacher)	1	0.9	9.00	0.24
Agonus acipenserinus (sturgeon poacher)	3	2.8	35.00	0.93
Stichaeidae (prickleback)	1	0.9	10.00	0.27
Ammodytes hexapterus (Pacific sand lance)	8	7.5	89.26	2.37
Pleuronectidae (flatfish)	19	17.9	365.96	9.74
Limanda aspera (yellowfin sole)	7	6.6	245.00	6.52
Limanda proboscidea (longhead dab)	2	1.9	72.90	1.94
Pleuronectes quadrituberculatus (Alaska plaice)	1	0.9	150.00	3.99
Unidentified organic material	6	5.7	130.05	3.46

Total number of stomachs	121
Total with food	106
Total prey weight (g)	3,758.48
Feeding diversity by weight	9.79

Table 17.--Food habits of great sculpin, Myoxocephalus polyacanthocephalus, determined from quantitative shipboard stomach scans in the eastern Bering Sea.

Prey name	Freq. occur.	%Freq. occur.	Total weight	%Total weight
Polychaeta (worm)	17	4.8	66.70	0.23
Polynoidae (polychaete)	2	0.6	9.25	0.03
Eunoe nodosa (polychaete)	2	0.6	10.25	0.04
Gastropoda (snail)	22	6.2	272.52	0.95
Yoldia scissurata (clam)	1	0.3	3.75	0.01
Octopoda (octopus)	1	0.3	42.00	0.15
Peracarida Mysidacea (mysid)	1	0.3	13.50	0.05
Gammaridea (amphipod)	9	2.5	26.45	0.09
Amphipoda Hyperiidea (amphipod)	7	2.0	11.80	0.04
Euphausiacea (euphausiid)	1	0.3	0.40	0.00
Decapoda (shrimp and crab)	3	0.8	4.79	0.02
Eucarida Decapoda Reptantia (crab)	11	3.1	91.10	0.32
Pleocyemata Caridea (shrimp)	15	4.2	40.05	0.14
Lebbeus groenlandicus (shrimp)	1	0.3	4.00	0.01
Pandalus goniurus (shrimp)	9	2.5	95.25	0.33
Argis sp. (shrimp)	4	1.1	39.50	0.14
Eucarida Decapoda Natantia (shrimp)	11	3.1	79.25	0.28
Pagurus sp. (hermit crab)	1	0.3	4.00	0.01
Pagurus trigonocheirus (hermit crab)	1	0.3	40.00	0.14
Paralithodes sp. (king crab)	1	0.3	7.40	0.03
Decapoda Brachyura (crab)	1	0.3	42.00	0.15
Majidae (decorator crab)	1	0.3	3.00	0.01
Hyas sp. (lyre crab)	12	3.4	251.50	0.88
Hyas lyratus (lyre crab)	1	0.3	75.00	0.26
Hyas coarctatus (lyre crab)	4	1.1	125.00	0.44
Hyas coarctatus alutaceus (lyre crab)	5	1.4	93.30	0.33
Chionoecetes sp. (Tanner crab)	65	18.4	2042.95	7.12
Chionoecetes opilio (Tanner crab)	145	41.1	11033.71	38.47
Chionoecetes bairdi (Tanner crab)	35	9.9	914.45	3.19
Echiura (marine worm)	10	2.8	158.25	0.55
Echiurus sp. (marine worm)	2	0.6	19.00	0.07
Ophiuroidae Ophiurida (brittle star)	1	0.3	6.75	0.02
Osteichthyes Teleostei (fish)	47	13.3	1575.60	5.49
Osmeridae (smelts)	2	0.6	14.15	0.05
Mallotus villosus (capelin)	4	1.1	225.50	0.79
Gadidae (gadid fish)	1	0.3	25.50	0.09
Gadus macrocephalus (Pacific cod)	3	0.8	279.40	0.97
Theragra chalcogramma (walleye pollock)	46	13.0	5722.14	19.95
Agonidae (poacher)	2	0.6	21.00	0.07
Liparis sp. (snailfish)	2	0.6	12.00	0.04
Pleuronectidae (flatfish)	17	4.8	742.65	2.59
Atheresthes sp. (flounder)	2	0.6	170.00	0.59
Hippoglossoides elassodon (flathead sole)	1	0.3	120.00	0.42
Lepidopsetta bilineata (rock sole)	11	3.1	954.50	3.33
Limanda aspera (yellowfin sole)	22	6.2	1674.26	5.84

Table 17.--Continued.

Prey name	Freq. occur.	%Freq. occur.	Total weight	%Total weight
Unidentified organic material	11	3.1	62.38	0.22
Unidentified eggs	1	0.3	40.00	0.14
Fishery discards	8	2.3	657.35	2.29
Unidentified material	1	0.3	0.10	0.00

Total number of stomachs	427
Total with food	353
Total prey weight (g)	28680.18
Feeding diversity by weight	11.22

Table 18.--Food habits of sturgeon poacher, Agonus acipenserinus, determined from quantitative shipboard stomach scans in the eastern Bering Sea.

Prey name	Freq. occur.	%Freq. occur.	Total weight	%Total weight
Calanoida (copepod)	1	4.5	0.05	0.22
Amphipoda (amphipod)	10	45.5	9.15	39.96
Gammaridea (amphipod)	9	40.9	9.25	40.39
Decapoda (shrimp and crab)	4	18.2	2.40	10.48
Unidentified organic material	12	54.5	2.05	8.95

Total number of stomachs	24
Total with food	22
Total prey weight (g)	22.9
Feeding diversity by weight	3.68

Table 19.--Food habits of Pacific sandfish, Trichodon trichodon, determined from quantitative shipboard stomach scans in the eastern Bering Sea.

Prey name	Freq. occur.	%Freq. occur.	Total weight	%Total weight
Calanoida (copepod)	1	2.8	5.00	1.21
Gammaridea (amphipod)	1	2.8	0.25	0.06
Decapoda (shrimp and crab)	1	2.8	1.00	0.24
Osteichthyes Teleostei (fish)	26	72.2	212.25	51.45
Gadidae (gadid fish)	5	13.9	94.40	22.88
Theragra chalcogramma (walleye pollock)	7	19.4	92.60	22.45
Unidentified organic material	5	13.9	7.00	1.70

Total number of stomachs	39
Total with food	36
Total prey weight (g)	412.50
Feeding diversity by weight	2.68

Table 20.--Food habits of rex sole, Glyptocephalus zachirus, determined from quantitative shipboard stomach scans in the eastern Bering Sea.

Prey name	Freq. occur.	%Freq. occur.	Total weight	%Total weight
Polychaeta (worm)	54	67.5	50.43	23.34
Bivalvia (clam)	1	1.3	0.06	0.03
Gammaridea (amphipod)	32	40.0	75.37	34.88
Amphipoda Hyperiidea (amphipod)	2	2.5	0.23	0.11
Euphausiacea (euphausiid)	11	13.8	10.07	4.66
Pleocyemata Caridea (shrimp)	44	55.0	70.49	32.62
Chionoecetes sp. (Tanner crab)	3	3.7	3.63	1.68
Echiuridae (marine worm)	12	15.0	5.29	2.45
Osteichthyes Teleostei (fish)	1	1.3	0.10	0.05
Unidentified organic material	3	3.7	0.44	0.20

Total number of stomachs	83
Total with food	80
Total prey weight (g)	216.10
Feeding diversity by weight	4.28

Table 21.--Food habits of flathead sole, Hippoglossoides elassodon, determined from quantitative shipboard stomach scans in the eastern Bering Sea.

Prey name	Freq. occur.	%Freq. occur.	Total weight	%Total weight
Scyphozoa (jellyfish)	3	4.3	16.45	3.44
Polychaeta (worm)	33	47.8	100.95	21.11
Gastropoda (snail)	1	1.4	2.00	0.42
Bivalvia (clam)	5	7.2	1.80	0.38
Cephalopoda (squid and octopus)	2	2.9	16.80	3.51
Crustacea	2	2.9	0.11	0.02
Euphausiacea (euphausiid)	32	46.4	51.90	10.85
Decapoda (shrimp and crab)	1	1.4	0.30	0.06
Eucarida Decapoda Reptantia (crab)	1	1.4	0.30	0.06
Pleocyemata Caridea (shrimp)	4	5.8	9.50	1.99
Crangon sp. (shrimp)	1	1.4	2.40	0.50
Echiura (marine worm)	22	31.9	141.00	29.49
Echiuridae (marine worm)	1	1.4	6.00	1.25
Ophiuroidea (basket and brittle star)	29	42.0	39.55	8.27
Ophiuroidae Ophiurida (brittle star)	2	2.9	0.90	0.19
Echinoidea (sea urchin and sand dollar)	7	10.1	8.80	1.84
Chaetognatha (arrow worm)	8	11.6	30.20	6.32
Osteichthyes Teleostei (fish)	5	7.2	32.09	6.71
Theragra chalcogramma (walleye pollock)	1	1.4	12.00	2.51
Zoarcidae (eelpout)	1	1.4	2.00	0.42
Unidentified organic material	3	4.3	3.10	0.65

Total number of stomachs	86
Total with food	69
Total prey weight (g)	478.13
Feeding diversity by weight	7.84

Table 22.--Food habits of rock sole, Lepidopsetta bilineata, determined from quantitative shipboard stomach scans in the eastern Bering Sea.

Prey name	Freq. occur.	%Freq. occur.	Total weight	%Total weight
Polychaeta (worm)	121	53.5	346.23	38.22
Aphroditidae (sea mouse)	3	1.3	8.64	0.95
Nephtyidae (polychaete)	5	2.2	23.30	2.57
Mollusca	1	0.4	1.10	0.12
Bivalvia (clam)	33	14.6	49.33	5.45
Copepoda	2	0.9	0.45	0.05
Calanoida (copepod)	13	5.8	10.85	1.20
Cumacea (cumacean)	4	1.8	6.40	0.71
Amphipoda (amphipod)	1	0.4	0.08	0.01
Gammaridea (amphipod)	17	7.5	19.55	2.16
Lysianassidae (amphipod)	10	4.4	8.15	0.90
Amphipoda Hyperiidea (amphipod)	3	1.3	1.90	0.21
Euphausiacea (euphausiid)	3	1.3	0.79	0.09
Decapoda (shrimp and crab)	2	0.9	0.11	0.01
Eucarida Decapoda Reptantia (crab)	10	4.4	23.90	2.64
Pleocyemata Caridea (shrimp)	17	7.5	17.60	1.94
Eucarida Decapoda Natantia (shrimp)	11	4.9	5.05	0.56
Paguridae (hermit crab)	4	1.8	6.50	0.72
Paralithodes sp. (king crab)	1	0.4	0.13	0.01
Decapoda Brachyura (crab)	3	1.3	1.82	0.20
Majidae (decorator crab)	1	0.4	1.20	0.13
Hyas sp. (lyre crab)	1	0.4	0.92	0.10
Chionoecetes sp. (Tanner crab)	1	0.4	4.00	0.44
Chionoecetes opilio (Tanner crab)	1	0.4	1.25	0.14
Chionoecetes bairdi (Tanner crab)	2	0.9	3.75	0.41
Sipuncula (marine worm)	3	1.3	5.90	0.65
Echiura (marine worm)	1	0.4	8.25	0.91
Echiuridae (marine worm)	16	7.1	35.38	3.91
Echiurus sp. (marine worm)	4	1.8	20.84	2.30
Echiurus echiurus (marine worm)	7	3.1	16.15	1.78
Priapulida (worm)	2	0.9	12.00	1.32
Asteroidea (starfish)	1	0.4	0.12	0.01
Ophiuroidea (basket and brittle star)	1	0.4	0.40	0.04
Ophiuroidae Ophiurida (brittle star)	31	13.7	60.16	6.64
Echinoidea (sea urchin and sand dollar)	4	1.8	4.60	0.51
Clypeasteridae (sand dollar)	7	3.1	13.50	1.49
Osteichthyes Teleostei (fish)	9	4.0	47.15	5.21
Gadidae (gadid fish)	1	0.4	5.25	0.58
Theragra chalcogramma (walleye pollock)	1	0.4	12.00	1.32
Ammodytes hexapterus (Pacific sand lance)	1	0.4	2.60	0.29
Unidentified organic material	27	11.9	43.73	4.83
Unidentified worm-like organisms	13	5.8	16.50	1.82
Fishery discards	7	3.1	53.80	5.94
Unidentified material	2	0.9	4.50	0.50

Table 23.--Food habits of longhead dab, Limanda proboscidea, determined from quantitative shipboard stomach scans in the eastern Bering Sea.

Prey name	Freq. occur.	%Freq. occur.	Total weight	%Total weight
Polychaeta (worm)	20	90.9	46.09	77.33
Bivalvia (clam)	1	4.5	0.45	0.76
Calanoida (copepod)	3	13.6	4.26	7.15
Cumacea (cumacean)	1	4.5	0.15	0.25
Gammaridea (amphipod)	7	31.8	8.65	14.51

Total number of stomachs	24
Total with food	22
Total prey weight (g)	59.60
Feeding diversity by weight	2.82

Table 24.--Food habits of starry flounder, Platichthys stellatus, determined from quantitative shipboard stomach scans in the eastern Bering Sea.

Prey name	Freq. occur.	%Freq. occur.	Total weight	%Total weight
Polychaeta (worm)	3	10.7	11.23	2.44
Gastropoda (snail)	1	3.6	0.99	0.21
Bivalvia (clam)	23	82.1	441.63	95.85
Gammaridea (amphipod)	1	3.6	0.08	0.02
Eucarida Decapoda Reptantia (crab)	1	3.6	2.01	0.44
Ophiuroidae Ophiurida (brittle star)	1	3.6	2.50	0.54
Theragra chalcogramma (walleye pollock)	1	3.6	2.00	0.43
Unidentified organic material	3	10.7	0.30	0.07

Total number of stomachs	60
Total with food	28
Total prey weight (g)	460.72
Feeding diversity by weight	3.00

Table 25.--Food habits of Alaska plaice, Pleuronectes quadrituberculatus, in the eastern Bering Sea determined from quantitative laboratory analysis.

Prey name	%Total number	%Freq. occur.	Total weight	%Total weight
Rhizopodea Foraminifera (foram)	2.3	31.0	0.29	0.10
Hydrozoa (jellyfish)	0.0	1.1	0.00	0.00
Sertulariidae (hydroid)	0.1	1.1	0.00	0.00
Digenea (flatworm)	0.0	1.1	0.02	0.01
Cestoda (flatworm)	0.1	3.4	0.06	0.02
Annelida (worm)	0.1	3.4	2.71	0.97
Polychaeta (worm)	5.3	77.0	24.21	8.64
Aphroditidae (sea mouse)	0.1	1.1	8.11	2.89
Polynoidae (polychaete)	1.2	23.0	6.40	2.28
Phyllodocidae (polychaete)	0.8	23.0	0.50	0.18
Nereidae (polychaete)	0.3	3.4	0.23	0.08
Nephtyidae (polychaete)	0.7	13.8	72.97	26.04
Nephtys sp. (polychaete)	0.3	6.9	37.39	13.34
Onuphis holobranchiata (polychaete)	0.0	1.1	0.10	0.04
Onuphis parva (polychaete)	0.0	1.1	0.04	0.01
Lumbrineris sp. (polychaete)	0.1	2.3	0.01	0.00
Lumbrineris latreilli (polychaete)	0.1	3.4	0.26	0.09
Lumbrineris minuta (polychaete)	0.0	1.1	0.07	0.02
Orbiniidae (polychaete)	0.5	2.3	0.06	0.02
Scoloplos armiger (polychaete)	0.1	2.3	0.08	0.03
Arididea sp. (polychaete)	0.1	1.1	0.02	0.01
Spionidae (polychaete)	0.0	1.1	0.01	0.00
Prionospio sp. (polychaete)	0.1	2.3	0.01	0.00
Spiochaetopterus typicus (polychaete)	0.0	1.1	0.09	0.03
Cirratulidae (polychaete)	0.5	10.3	4.32	1.54
Opheliidae (polychaete)	0.8	20.7	3.73	1.33
Ophelia limacina (polychaete)	0.2	5.7	0.78	0.28
Travisia sp. (polychaete)	0.1	2.3	0.13	0.05
Travisia forbesii (polychaete)	0.1	4.6	0.30	0.11
Sternaspis scutata (polychaete)	0.0	1.1	0.14	0.05
Capitellidae (polychaete)	0.0	1.1	0.04	0.01
Capitella capitata (polychaete)	0.0	1.1	0.01	0.00
Maldanidae (polychaete)	1.8	31.0	2.99	1.07
Maldane sarsi (polychaete)	0.3	4.6	2.81	1.00
Maldanella harai (polychaete)	0.5	1.1	1.46	0.52
Nicomache lumbricalis (polychaete)	0.5	6.9	3.79	1.35
Nicomache personata (polychaete)	0.0	1.1	0.09	0.03
Notoproctus sp. (polychaete)	0.1	3.4	0.98	0.35
Axiothella catenata (polychaete)	0.1	2.3	2.29	0.82
Praxillella gracilis (polychaete)	0.0	1.1	0.01	0.00
Praxillella praetermissa (polychaete)	0.1	2.3	0.04	0.01
Rhodine sp. (polychaete)	0.2	4.6	0.21	0.07
Oweniidae (polychaete)	0.0	1.1	0.01	0.00
Pectinariidae (polychaete)	0.1	4.6	0.70	0.25
Cistenides hyperborea (polychaete)	0.0	1.1	0.04	0.02
Ampharetidae (polychaete)	0.1	4.6	0.57	0.20
Amphicteis sp. (polychaete)	0.0	1.1	0.89	0.32

Table 25.--Continued.

Prey name	%Total number	%Freq. occur.	Total weight	%Total weight
Terebellidae (polychaete)	0.3	6.9	4.90	1.75
Polycirrus sp. (polychaete)	0.1	2.3	0.28	0.10
Terebellides stroemi (polychaete)	0.6	10.3	3.26	1.16
Sabellidae (polychaete)	0.5	13.8	4.59	1.64
Chone sp. (polychaete)	0.5	9.2	27.45	9.80
Mollusca	0.1	1.1	0.14	0.05
Gastropoda (snail)	1.3	28.7	2.75	0.98
Bivalvia (clam)	1.2	26.4	7.03	2.51
Nucula (clam)	0.0	1.1	0.01	0.00
Arthropoda Pycnogonida (sea spider)	0.0	1.1	0.00	0.00
Ostracoda	0.1	2.3	0.03	0.01
Mysidae (mysid)	0.0	1.1	0.00	0.00
Cumacea (cumacean)	0.1	2.3	0.02	0.01
Leucon sp. (cumacean)	0.0	1.1	0.01	0.00
Gammaridea (amphipod)	68.3	78.2	17.38	6.20
Ampeliscidae (amphipod)	0.8	20.7	0.56	0.20
Ampelisca macrocephala (amphipod)	0.0	1.1	0.01	0.00
Byblis crassicornis (amphipod)	0.0	1.1	0.10	0.04
Byblis longicornis (amphipod)	0.0	1.1	0.03	0.01
Byblis abyssi (amphipod)	0.0	1.1	0.16	0.06
Byblis erythrops (amphipod)	0.0	1.1	0.15	0.05
Isaeidae (amphipod)	2.6	5.7	0.77	0.27
Lysianassidae (amphipod)	0.0	1.1	0.03	0.01
Ualettiopsis sp. (amphipod)	0.0	1.1	0.02	0.01
Oedicerotidae (amphipod)	0.1	2.3	0.01	0.00
Phoxocephalidae (amphipod)	0.1	3.4	0.02	0.01
Crangonidae (shrimp)	0.1	2.3	0.09	0.03
Eucarida Decapoda Natantia (shrimp)	0.0	1.1	0.00	0.00
Paguridae (hermit crab)	0.1	3.4	0.08	0.03
Majidae (decorator crab)	0.0	1.1	0.01	0.00
Sipuncula (marine worm)	0.2	9.2	9.89	3.53
Echiurus sp. (marine worm)	2.7	40.2	14.52	5.18
Echiurus echiurus (marine worm)	1.0	5.7	0.99	0.35
Ophiuroidae Ophiurida (brittle star)	0.4	12.6	0.24	0.09
Amphiuridae (brittle star)	0.1	1.1	0.02	0.01
Amphiodia Euryaspis (brittle star)	0.1	1.1	0.12	0.04
Echinoidea (sea urchin and sand dollar)	0.0	1.1	0.30	0.11
Enteropneusta (acorn worm)	0.0	1.1	0.13	0.04
Osteichthyes Teleostei (fish)	0.1	2.3	0.05	0.02
Unid. organic material	0.3	13.8	3.47	1.24
Unidentified eggs	0.1	1.1	0.01	0.00
Unidentified tube	0.1	5.7	0.65	0.23

Total number of stomachs	99
Total with food	87
Total prey count	4150
Total prey weight (g)	280.22
Feeding diversity by weight	37.19

Table 26.--Food habits of Alaska plaice, *Pleuronectes quadrituberculatus*, determined from quantitative shipboard stomach scans in the eastern Bering Sea.

Prey name	Freq. occur.	%Freq. occur.	Total weight	%Total weight
Polychaeta (worm)	144	54.1	1010.49	51.67
Hirudinea (leech)	1	0.4	1.05	0.05
Gastropoda (snail)	2	0.8	0.11	0.01
Bivalvia (clam)	98	36.8	691.25	35.35
Copepoda	8	3.0	2.93	0.15
Peracarida Mysidacea (mysid)	1	0.4	0.21	0.01
Pericarida Mysidacea Mysida (mysid)	1	0.4	0.60	0.03
Cumacea (cumacean)	1	0.4	4.50	0.23
Amphipoda (amphipod)	3	1.1	3.10	0.16
Gammaridea (amphipod)	24	9.0	32.37	1.65
Amphipoda Hyperiidea (amphipod)	8	3.0	5.46	0.28
Euphausiacea (euphausiid)	20	7.5	11.78	0.60
Decapoda (shrimp and crab)	1	0.4	0.14	0.01
Pleocyemata Caridea (shrimp)	6	2.3	8.45	0.43
Eucarida Decapoda Natantia (shrimp)	1	0.4	1.20	0.06
Chionoecetes opilio (Tanner opilio)	2	0.8	38.00	1.94
Echiura (marine worm)	16	6.0	27.85	1.42
Echiuridae (marine worm)	8	3.0	32.20	1.65
Ophiuroidea (basket and brittle star)	4	1.5	3.57	0.18
Ophiuroidae Ophiurida (brittle star)	5	1.9	4.45	0.23
Larvacea Copelata	3	1.1	0.40	0.02
Osteichthyes Teleostei (fish)	2	0.8	2.40	0.12
Gadidae (gadid fish)	1	0.4	0.20	0.01
Unidentified organic material	17	6.4	24.83	1.27
Unidentified worm-like organisms	1	0.4	2.10	0.11
Unidentified algae	3	1.1	0.30	0.02

Total number of stomachs	396
Total with food	266
Total prey weight (g)	1955.63
Feeding diversity by weight	8.20

Table 27.--Food habits of Pacific halibut, Hippoglossus stenolepis, in the eastern Bering Sea determined by quantitative laboratory analysis.

Prey name	%Total number	%Freq. occur.	Total weight	%Total weight
Polychaeta (worm)	2.1	8.5	50.71	0.26
Nephtyidae (polychaete)	0.1	0.4	24.24	0.12
Mollusca	0.1	0.4	3.51	0.02
Gastropoda (snail)	0.3	1.8	20.76	0.11
Buccinum sp. (snail)	0.1	0.4	0.07	0.00
Bivalvia (clam)	7.7	5.1	146.64	0.75
Nuculana sp. (clam)	0.1	0.4	0.18	0.00
Cephalopoda (squid and octopus)	0.1	0.4	7.41	0.04
Teuthoidea (squid)	0.1	0.7	0.44	0.00
Balanomorpha (barnacle)	0.1	0.4	0.29	0.00
Mysidae (mysid)	0.1	0.4	0.02	0.00
Neomysis rayii (mysid)	0.1	0.4	0.05	0.00
Cumacea (cumacean)	0.1	0.4	0.04	0.00
Idoteidae (isopod)	0.1	0.4	0.16	0.00
Gammaridea (amphipod)	0.5	2.6	0.43	0.00
Lysianassidae (amphipod)	0.6	1.1	2.79	0.01
Euphausiacea (euphausiid)	0.1	0.7	0.09	0.00
Eucarida Decapoda Reptantia (crab)	0.1	0.7	3.51	0.02
Pleocyemata Caridea (shrimp)	1.5	1.8	7.95	0.04
Hippolytidae (shrimp)	0.1	0.4	0.79	0.00
Eualus avinus (shrimp)	0.1	0.4	0.23	0.00
Crangonidae (shrimp)	0.8	3.3	5.73	0.03
Crangon sp. (shrimp)	0.1	0.4	0.50	0.00
Crangon dalli (shrimp)	3.3	2.2	31.33	0.16
Argis alaskensis (shrimp)	0.4	0.4	4.88	0.03
Eucarida Decapoda Natantia (shrimp)	0.1	0.4	0.57	0.00
Anomura (crab)	0.1	0.4	0.70	0.00
Paguridae (hermit crab)	9.2	36.8	1196.70	6.16
Lithodidae (king crab)	0.1	0.7	13.16	0.07
Majidae (decorator crab)	0.5	2.6	11.89	0.06
Oregonia sp. (decorator crab)	0.1	0.4	0.58	0.00
Oregonia gracilis (decorator crab)	0.1	0.4	1.46	0.01
Hyas sp. (lyre crab)	0.2	0.7	2.77	0.01
Hyas lyratus (lyre crab)	0.8	1.8	28.91	0.15
Hyas coarctatus (lyre crab)	3.2	4.0	348.36	1.79
Chionoecetes sp. (Tanner crab)	2.4	4.8	73.14	0.38
Chionoecetes opilio (Tanner crab)	2.4	4.0	293.86	1.51
Chionoecetes bairdi (Tanner crab)	12.8	24.3	1199.07	6.17
Atelecyclidae (crab)	0.1	0.4	12.66	0.07
Erimacrus isenbeckii (horse hair crab)	0.5	2.9	177.80	0.92
Cancer oregonensis (pygmy cancer crab)	0.2	0.7	5.48	0.03
Echiurus sp. (marine worm)	0.1	1.8	37.58	0.19
Ectoprocta (bryozoan)	0.1	0.4	0.04	0.00
Asteriidae (starfish)	0.1	0.4	0.49	0.00
Ophiuroidea (basket & brittle star)	0.1	0.4	0.05	0.00

Table 27.--Continued.

Prey name	%Total number	%Freq. occur.	Total weight	%Total weight
Ophiuroidea Phrynophiurida (basket star)	0.1	0.4	0.02	0.00
Ascidiacea (sea squirt)	0.1	0.4	7.73	0.04
Boltenia sp. (sea onion)	0.1	0.4	5.10	0.03
Osteichthyes Teleostei (fish)	25.5	37.5	1714.61	8.83
Non-gadoid fish remains	0.1	0.4	0.98	0.01
Clupea harengus pallasi (Pacific herring)	0.4	2.2	937.35	4.83
Gadidae (gadid fish)	1.5	8.1	1186.16	6.11
Gadus macrocephalus (Pacific cod)	0.3	18.6	561.28	2.89
Theragra chalcogramma (walleye pollock)	8.5	24.6	7378.89	37.99
Zoarcidae (eelpout)	0.2	0.7	23.53	0.12
Lycodes brevipes (shortfin eelpout)	0.2	1.1	13.39	0.07
Cottidae (sculpin)	1.7	4.8	20.37	0.10
Agonidae (poacher)	0.2	1.1	10.27	0.05
Agonus acipenserinus (sturgeon poacher)	0.2	1.5	56.33	0.29
Ptilichthys goodei (quillfish)	0.1	0.7	26.28	0.14
Stichaeidae (prickleback)	0.4	0.7	90.05	0.46
Ammodytes hexapterus (Pacific sand lance)	1.8	4.4	164.92	0.85
Pleuronectidae (flatfish)	2.7	10.3	648.89	3.34
Hippoglossoides elassodon (flathead sole)	0.2	1.1	181.91	0.94
Lepidopsetta bilineata (rock sole)	0.2	0.4	10.41	0.05
Limanda aspera (yellowfin sole)	1.8	5.5	1431.64	7.37
Limanda proboscidea (longhead dab)	0.1	0.4	195.18	1.00
Unidentified organic material	0.1	0.4	1.47	0.01
Unidentified eggs	0.1	0.4	0.28	0.00
Fishery discards	1.8	4.8	1028.30	5.29
Unidentified tube	0.3	1.5	11.34	0.06
Unidentified algae	0.1	0.4	0.05	0.00

Total number of stomachs	301
Total with food	272
Total prey count	1679
Total prey weight (g)	19424.72
Feeding diversity by weight	16.79

Table 28.--Food habits of Pacific halibut, Hippoglossus stenolepis, determined from quantitative shipboard stomach scans in the eastern Bering Sea.

Prey name	Freq. occur.	%Freq. occur.	Total weight	%Total weight
Polychaeta (worm)	3	17.6	8.50	0.45
Gastropoda (snail)	1	5.9	0.29	0.02
Eucarida Decapoda Reptantia (crab)	2	11.8	12.10	0.64
Pleocyemata Caridea (shrimp)	1	5.9	2.50	0.13
Paguridae (hermit crab)	2	11.8	47.47	2.52
Decapoda Brachyura (crab)	1	5.9	0.60	0.03
Chionoecetes bairdi (Tanner crab)	3	17.6	17.95	0.95
Larvacea Copelata	1	5.9	0.20	0.01
Osteichthyes Teleostei (fish)	8	47.1	886.70	47.09
Gadidae (gadid fish)	1	5.9	30.00	1.59
Theragra chalcogramma (walleye pollock)	1	5.9	170.00	9.03
Ammodytes sp. (sand lance)	1	5.9	25.20	1.34
Ammodytes hexapterus (Pacific sand lance)	2	11.8	300.70	15.97
Pleuronectidae (flatfish)	3	17.6	296.40	15.74
Hippoglossoides elassodon (flathead sole)	1	5.9	82.50	4.38
Unidentified material	1	5.9	1.90	0.10

Total number of stomachs	18
Total with food	17
Total prey weight (g)	1882.99
Feeding diversity by weight	4.88

Table 29.--Summary of the utilization of several commercially important prey species as determined by quantitative shipboard scans of major predators in the eastern Bering Sea, 1985-86. Data are percentages by weight of the total diet of each predator.

	Prey Species			
Predators	*Theragra chalcogramma*	*Chionoecetes opilio*	*Chionoecetes bairdi*	*Limanda aspera*
Pacific cod	35.0	--	6.2	1.8
Alaska skate	34.9	12.5	--	--
Bigmouth sculpin	71.3	--	--	1.4
Great sculpin	--	38.5	3.2	5.8
Plain sculpin	--	30.7	0.2	6.5
Atka mackerel	46.2	--	--	--
Sablefish	26.0	--	--	--
Wattled eelpout	--	13.0	23.1	--
Pacific sandfish	22.4	--	--	--
Red Irish lord	0.2	10.6	2.3	--
Yellow Irish lord	2.9	4.8	3.1	--
Pacific Ocean perch	5.8	--	--	--
Flathead sole	2.5	--	--	--
Rock sole	1.3	0.4	0.1	--
Pacific halibut	--	1.0	9.0	--
Alaska plaice	--	1.9	--	--
Starry flounder	0.4	--	--	--

LITERATURE CITED

ALBERS, W. D., and P. J. ANDERSON.

1985. Diet of Pacific cod, Gadus macrocephalus, and predation on the northern pink shrimp, Pandalus borealis, in Pavlof Bay, Alaska. U.S. Natl. Mar. Fish. Serv., Fish. Bull. 83:601-610.

BAKKALA, R. G.

1984. Other species. In R. G. Bakkala and L.-L. Low (editors), Condition of groundfish resources of the eastern Bering Sea and Aleutian Islands region in 1983. U.S. Dep. Commer., NOAA Tech. Memo. NMFS F/NWC-53, 189 p.

BEST, E. A., and G. ST. PIERRE.

1986. Pacific halibut as predator and prey. Int. Pac. Halibut Comm. Tech. Rep. 21, 27 p.

BRODEUR, R. D., and W. G. PEARCY.

1984. Food habits and dietary overlap of some shelf rockfishes (Genus Sebastes) from the northeastern Pacific Ocean. U.S. Natl. Mar. Fish. Serv., Fish. Bull. 82:269-293.

BRODEUR, R. D., H. V. LORZ and W. G. PEARCY.

1987. Food habits and dietary variability of pelagic nekton off Oregon and Washington, 1979-1984. NOAA Tech. Rep. NMFS 57, 32 p.

CAILLIET, G. M., and J. P. BARRY.

1979. Comparison of food array overlap measures useful in fish feeding habits analysis. In S. J. Lipovsky and C. A. Simenstad (editors), Gutshop '78, Fish food habits studies; Proceedings of the 2nd Pacific

Northwest Technical Workshop, p. 67-79. Univ. Washington Division of Marine Resources, Washington Sea Grant WSG-WO-79-1.

FEDER, H. M.
1977. The distribution, abundance, diversity, and biology of benthic organisms in the Gulf of Alaska and the Bering Sea. In Environmental Assessment of the Alaskan Continental Shelf, Annual Reports 8:366-712. U.S. Dep. Commer., Natl. Oceanic. Atmos. Admin., Environ. Res. Lab., Boulder, CO.

FEDER, H. M.
1979. Distribution, abundance, community structure and trophic relationships of the nearshore benthos of Kodiak shelf. In Environmental Assessment of the Alaskan Continental Shelf, Annual Reports 3:84-207. U.S. Dep. Commer., Natl. Oceanic Atmos. Admin., Environ. Res. Lab., Boulder, CO.

FITCH, J. F., and R. J. LAVENBERG.
1968. Deep-water fishes of California. Univ. California Press, Berkeley, 155 p.

JEWETT, S. C.
1978. Summer food of the Pacific cod, Gadus macrocophalus, near Kodiak Island, Alaska. U.S. Natl. Mar. Fish. Serv., Fish. Bull. 76:700-705.

JEWETT, S. C., and H. M. FEDER.
1980. Autumn food of adult starry flounder, Platichthys stellatus, from the northeastern Bering Sea and the southeastern Chukchi Sea. J. Cons. Int. Explor. Mer 39:7-14.

JEWETT, S. C., and G. C. POWELL.

1979. Summer food of the sculpins, Myoxocephalus sp. and Hemilepidotus jordani, near Kodiak Island, Alaska.. Mar. Sci. Commun. 5:315-331.

KRAVITZ, M. J., W. G. PEARCY, and M. P. GUIN.

1976. Food of five species of co-occurring flatfishes on Oregon's Continental Shelf. U.S. Natl. Mar. Fish. Serv.., Fish. Bull. 74:984-990.

LINTON, L. R., R. W. DAVIES, and F. J. WRONA.

1981. Resource utilization indices: an assessment. J. Anim. Ecol. 50:283-292.

LIVINGSTON, P. A., and B. J. GOINEY, JR.

1983. Food habits literature of North Pacific marine fishes: A review and selected bibliography. U.S. Dep. Commer., NOAA Tech. Memo. NMFS F/NWC-54, 81 p.

LIVINGSTON, P. A., D. A. DWYER, D. L. WENCKER, M. S. YANG, and G. M. LANG.

1986. Trophic interactions of key fish species in the eastern Bering Sea. In Symposium on biological interactions in the North Pacific region and onfactors affecting recruitment, distribution, and abundance of non-anadromous species. Int. North Pac. Fish. Comm. Bull.. 47:49-65.

LYUBIMOVA, T. G.

1963. Osnovnye cherty biologii raspredeleniya Tikhookeanskogo morskogo okunya (Sebastodes alutus Gilbert) v zalive Alyaska (Basic aspects of the biology and distribution of Pacific rockfish (Sebastodes alutus Gilbert) in the Gulf of Alaska). Tr. Vses. Nauchno-Issled. Inst. Morsk. Rybn. Khoz. Okeanogr. 48 (Izv. Tikhookean. Nauchno-Issled. Inst. Rybn. Khoz. Okeanogr. 50):293-303. In Russ. (Transl. by Isr. Program Sci.

Transl., 1968, p. 308-318, In P. A. Moiseev (editor), Soviet fisheries investigations in the northeastern Pacific, Part 1, available U.S. Dep. Commer., Natl. Tech. Inf. Serv., Springfield, VA, as TT 67-51203).

MILLER, B. S.

1967. Stomach contents of adult starry flounder and sand sole in East Sound, Orcas Island, Washington. J. Fish. Res. Board Can. 24:2515-2526.

MINEVA, T. A.

1964. Materialy po biologii nekotorykh vidov kambal vostochnoi chasti Beringova morya (On the biology of some flatfishes in the eastern Bering Sea). Tr. Vses. Nauchno-Issled. Inst. Morsk. Rybn. Khoz. Okeanogr. 49 (Izv. Tikhookean. Nauchno-Issled. Inst. Rybvn. Khoz. Okeanogr. 51):215-224. In Russ. (Transl. by Isr. Program Sci. Transl., 1968, p. 227-235, In P. A. Moiseev (editor), Soviet fisheries investigations in the northeast Pacific, Part 2, available U.S. Dep. Commer., Natl. Tech. Inf. Serv., Springfield, VA, as TT 67-51204).

MITO, K. I.

1974. Food relationships among benthic fish populations in the Bering Sea. M.S. Thesis, Hokkaido Univ., Hakodate, Japan, 135 p.

NOVIKOV, N. P.

1964. Osnovnye cherty biologii tikhookeanskogo belokorogo pltusa (_Hippoglossus hippoglossus stenolepis_ Schmidt) y Beringovour more (Basic elements of the biology of the Pacific halibut (_Hippoglossus hippoglossus stenolepis_ Schmidt) in the Bering Sea). Tr. Vses. Nauchno-Issled. Inst. Morsk. Rybn. Khoz. Okeanogr. 49 (Izv. Tikhookean. Nauchno-Issled. Ist. Rybn. Khoz. Okeanogr. 51):167-204. In Russ. (Transl. by Isr. Program. Sci. Transl., 1968, p. 175-219 In P. A. Moiseev (editor), Soviet fisheries investigations in the northeast Pacific, Part 2, available U.S. Dep. Commer., Natl. Tech. Inf. Serv. Springfield, VA, as TT 67-51204).

NOVIKOV, N. P.

1970. Biologiia maloglazogo dolgokhovosta Chalinura pectoralis v severnoi chasti Tikhogo okeana (Biology of Chalinura pectoralis in the North Pacific). Tr. Vses. Nauchno-Issled. Inst. Morsk. Rybn. Khoz. Okeanogr. 70 (Izv. Tikhookean. Nauchno-Issled. Inst. Rybn. Khoz. Okeanogr. 72):300-326. In Russ. (Transl. by Isr. Program Sci. Transl., 1972, p. 304-331, In P.A. Moiseev (editor), Soviet fisheries investigations in the northeastern Pacific, Part 5, available U.S. Dep. Commer., Natl. Tech. Inf. Serv., Springfield,VA, as TT 71-50127).

ODUM, E. P.

1959. Fundamentals of ecology. W. B. Saunders Co., Philadelphia, PA, 546 p.

ROGERS, D. E., D. J. RABIN, B. J. ROGERS, K. GARRISON, and M. WANGERIN.

1979. Seasonal composition and food web relationships of marine organisms in the nearshore zone of Kodiak Island including ichthyo-plankton, meroplankton (shellfish), zooplankton, and fish. In Environmental Assessment of the Alaskan Continental Shelf, Annual Reports 4:529-662. U.S. Dep. Commer., Natl. Oceanic Atmos. Admin., Environ. Res. Lab., Boulder, CO.

RUMYANTSEV, A. I., and M. A. DARDA.

1970. Letniaia sel'd' vostochnoi chasti Beringova moria (Summer herring in the eastern Bering Sea). Tr. Vses. Nauchno-Issled. Inst. Morsk. Rybn. Khoz. Okeanogr. 70 (Izv. Tikhookean. Nauchno-Issled. Inst. Rybn.

Khoz. Okeanogr. 72):402-432. In Russ. (Transl. by Isr. Program Sci. Transl., 1972, p. 409-441, In P. A. Moiseev (editor), Soviet fisheries investigations in the northeast Pacific, Part 5, available U.S. Dep. Commer., Natl. Tech. Inf. Serv., Springfield, VA, as TT 71-50127).

SASAKI, T.

1985. Studies on the sablefish resources in the North Pacific Ocean. Far Seas Fish. Res. Lab. Bull. 22:1-108.

SCHOENER, T. W.

1970. Non-synchronous spatial overlap of lizards in patchy habitats. Ecology 51:408-418.

SHUBNIKOV, D. A.

1963. Nekotorye dannye po biologii ugol'noi ryby Beringova morya (Data on the biology of sablefish of the Bering Sea). Tr. Vses. Nauchno Issled. Inst. Morsk. Rybn. Khoz. Okeanogr. 48 (Izv. Tikhookean. Nauchno-Issled. Inst. Rybn. Khoz. Okeanogr. 50):271-295. In Russ. (Transl. by Isr. Program Sci. Transl., 1968, p. 287-296, In P. A.. Moiseev (editor), Soviet fisheries investigations in the northeast Pacific, Part 1, available U.S. Dep. Commer., Natl. Tech. Inf. Serv., Springfield, VA, as TT 67-51203).

SKALKIN, V. A.

1963. Pitanie kambal v yugo-vostochnoi chasti Beringova morya (Diet of flatfishes in the southeastern Bering Sea). Tr. Vses. Nauchno-Issled. Inst. Morsk. Rybn. Khoz. Okeanogr. 48 (Izv. Tikhookean. Nauchno-Issled. Inst. Rybn, Khoz. Okeanogr. 50):223-237. In Russ. (Transl. by Isr. Program Sci. Trans., 1968, p. 235-250 In P. A. Moiseev (editor), Soviet fisheries investigations in the northeast Pacific, Part 1, available U.S. Dep. Commer., Natl. Tech. Inf. Serv. Springfield, VA, as TT 67-51203).

SKALKIN, V. A.

1964. Pitanie morskikh okunei v Beringovum more (Diet of rockfish in the Bering Sea.) Tr. Vses. Nauchno-Issled. Inst. Morsk. Rybn. Khoz. Okeanogr. 49 (Izv. Tikhookean. Nauchno-Issled. Inst. Rybn. Khoz. Okeanogr. 51):151-166. In Russ. (Transl. by Isr. Program. Sci. Transl., 1968, p. 159-174, In P. A. Moiseev (editor), Soviet fisheries investigations in the northeast Pacific, Part 2, available U.S. Dep. Commer., Natl. Tech- Inf. Serv., Springfield, VA, as TT 67-51204).

SMITH, R. L., A. C. PAULSON, and J. R. ROSE.

1978. Food and feeding relationships in the benthic and demersal fishes of the Gulf of Alaska and Bering Sea. In Environmental Assessment of the Alaskan Continental Shelf, Final Reports, Biological Studies 1:33-107. U.S. Dep. Commer., Natl. Oceanic Atmos. Admin., Environ. Res. Lab., Boulder, CO.

SOMERTON, D., F. FUNK, K. MESMER, L. J. BLEDSOE, and K. THORNBURGH.

1978. A comparative study of the diets of Pacific ocean perch (Sebastes alutus) and walleye pollock (Theragra chalcogramma) in the Gulf of Alaska. NORFISH NPB8, 25 p. Washington Sea Grant Communications Program, University of Washington, Division of Marine Resources, 3716 Brooklyn Ave. NE, Seattle, WA 98195.

WAILES, G. H.

1936. Food of _Clupea pallasii_ in southern British Columbia waters. J. Biol. Board Can. 1:477-486.

WAKABAYASHI, K.

1986. Interspecific feeding relationships on the continental shelf of the eastern Bering Sea, with special reference to yellowfin sole. In Symposium on biological interactions in the North Pacific region and on factors affecting recruitment, distribution, and abundance of non-anadromous species. Int. North Pac. Fish. Comm. Bull. 47:3-30.

WESTRHEIM, J., and W. HARLING.

1983. Principal prey species and periodicity of their incidence in stomachs of trawl-caught Pacific cod (_Gadus macrocephalus_), rock sole (_Lepidopsetta bilineata_), and petrale sole (_Eopsetta jordani_), landed in British Columbia, 1950-1980. Can. Manuscr. Rep. Fish. Aquat. Sci. 1681, 315 pp.

APPENDIX

Yearly and Seasonal Summary of Stomach Sampling

Appendix Table l.--Yearly and seasonal summary of stomachs examined containing food and empty stomachs (in parentheses) for each predator.

a) Shipboard scans

Year	1985		1986				
Season	Summer	Fall	Winter	Spring	Summer	Fall	Totals
Predators							
Alaska skate	5	3 (1)					8 (1)
Pacific herring	7	3 (1)		30 (5)	171 (14)	36 (4)	247 (24)
Pacific cod	9	44 (1)	1			20	74 (1)
Twolined eelpout	4 (7)	4					8 (7)
Shortfin eelpout	3 (1)	(7)			13		16 (8)
Wattled eelpout					19 (9)		19 (9)
Pectoral rattail		12 (4)			8		20 (4)
Pacific Ocean perch	1 (3)	2 (6)		(1)	16 (17)	(4)	19 (31)
Northern rockfish		4 (4)			16 (1)	3 (1)	23 (6)
Atka mackerel				24 (4)	36 (4)		60 (8)
Sablefish		19 (9)			40 (13)	83 (17)	142 (39)
Red Irish lord		3 (1)			12	56	71 (1)
Yellow Irish lord	2	42 (3)		71 (7)	55 (9)	104	274 (19)
Bigmouth sculpin					36 (16)		36 (16)
Plain sculpin	2			35 (5)	55 (8)	14 (2)	106 (15)
Great sculpin	37 (7)	62 (20)		127 (16)	126 (30)	1 (1)	353 (74)
Sturgeon poacher		6 (2)			16		22 (2)
Pacific sandfish		36 (3)					36 (3)
Rex sole	4				21 (1)	55 (2)	80 (3)
Flathead sole	18 (2)	30 (2)	8 (4)	4 (8)	9 (1)		69 (17)
Rock sole		48 (21)	11 (48)	57 (49)	106 (42)	4 (1)	226(161)
Longhead dab					22 (2)		22 (2)
Starry flounder		8 (4)	(1)	(10)	20 (17)		28 (32)
Alaska plaice	38 (13)	106 (27)	3	48 (76)	65 (13)	6 (1)	266(130)
Pacific halibut					5 (1)	12	17 (1)
TOTALS	130 (33)	432(116)	23 (54)	396(180)	867(198)	394 (33)	2242(614)

b) Laboratory analysis

Year	1983	1984	1985	
Season	Fall	Summer	Summer	Totals
Predators				
Sablefish			31 (3)	31 (3)
Alaska plaice	13 (3)	74 (9)		87 (12)
Pacific halibut		82 (16)	190 (13)	272 (29)
TOTALS	13 (3)	156 (25)	221 (16)	390 (44)

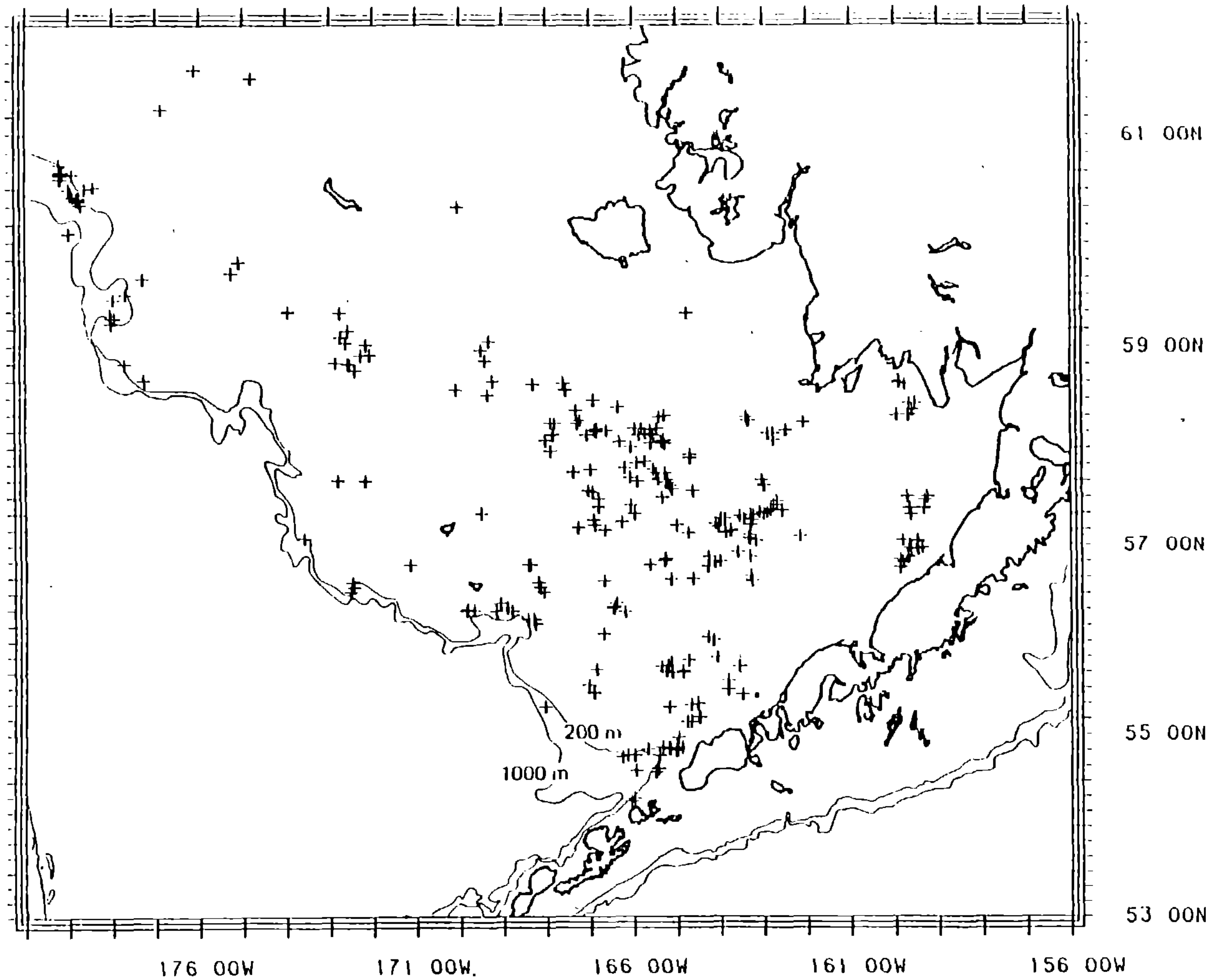
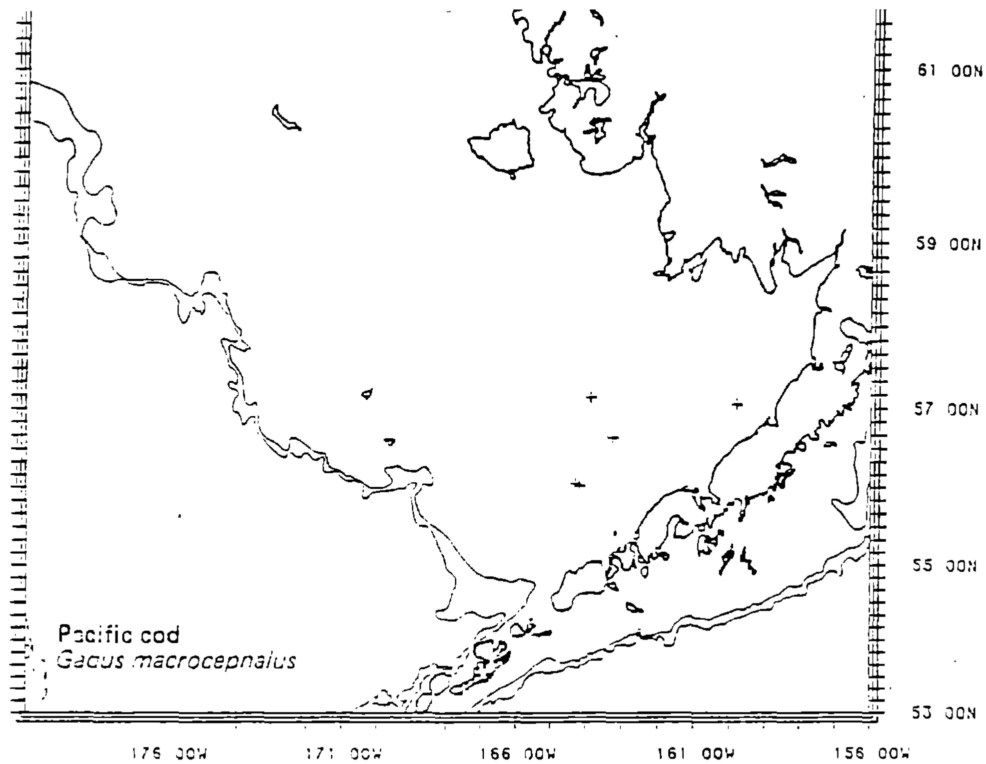


Figure 1.--Locations where stomach scan collections were taken in the eastern Bering Sea in 1985 and-1986.



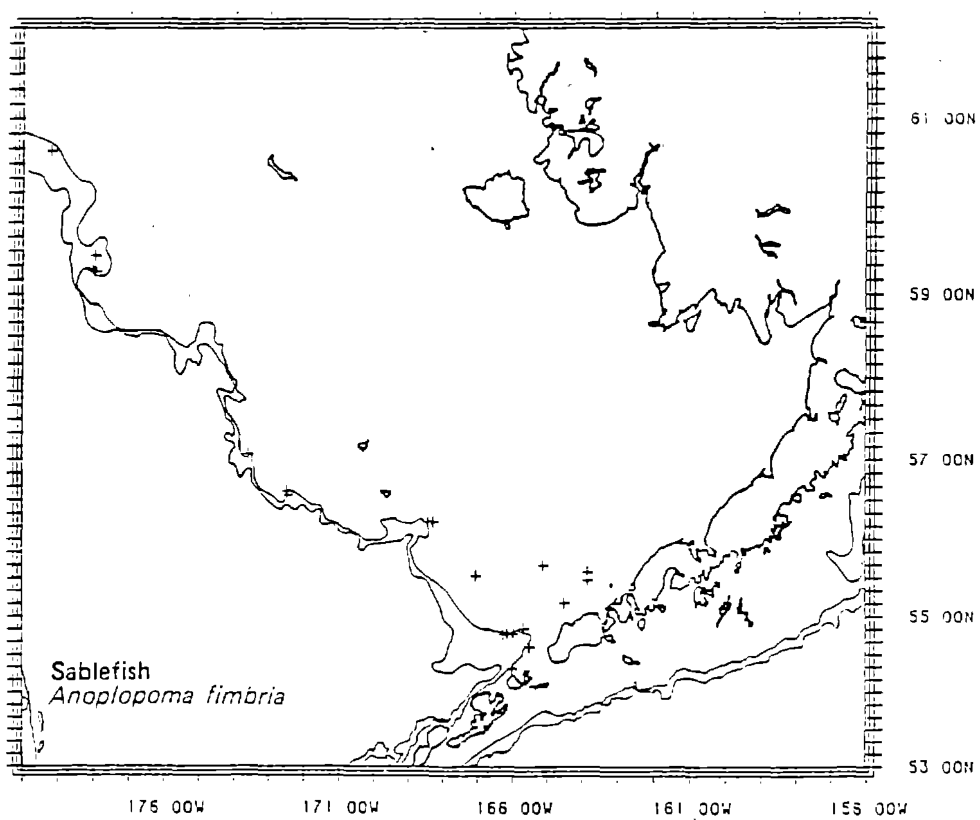
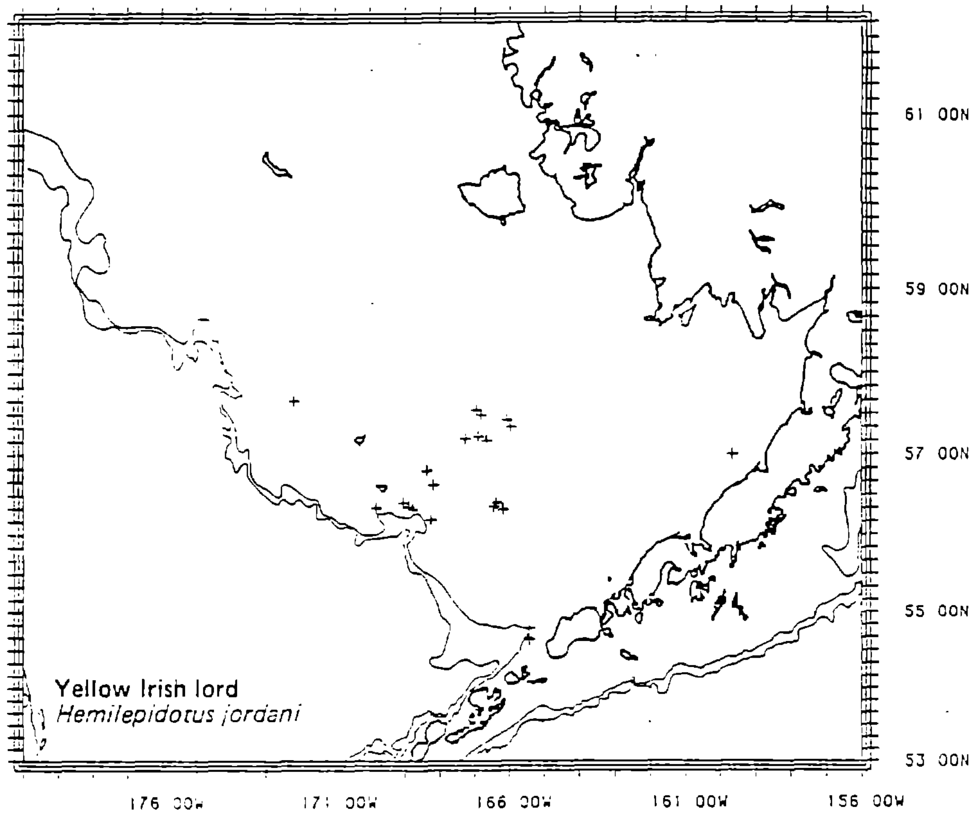


Figure 2.--Locations where stomach scan collections of Pacific cod were taken.

Figure 3 .--Locations where stomach scan collections of sablefish were taken.



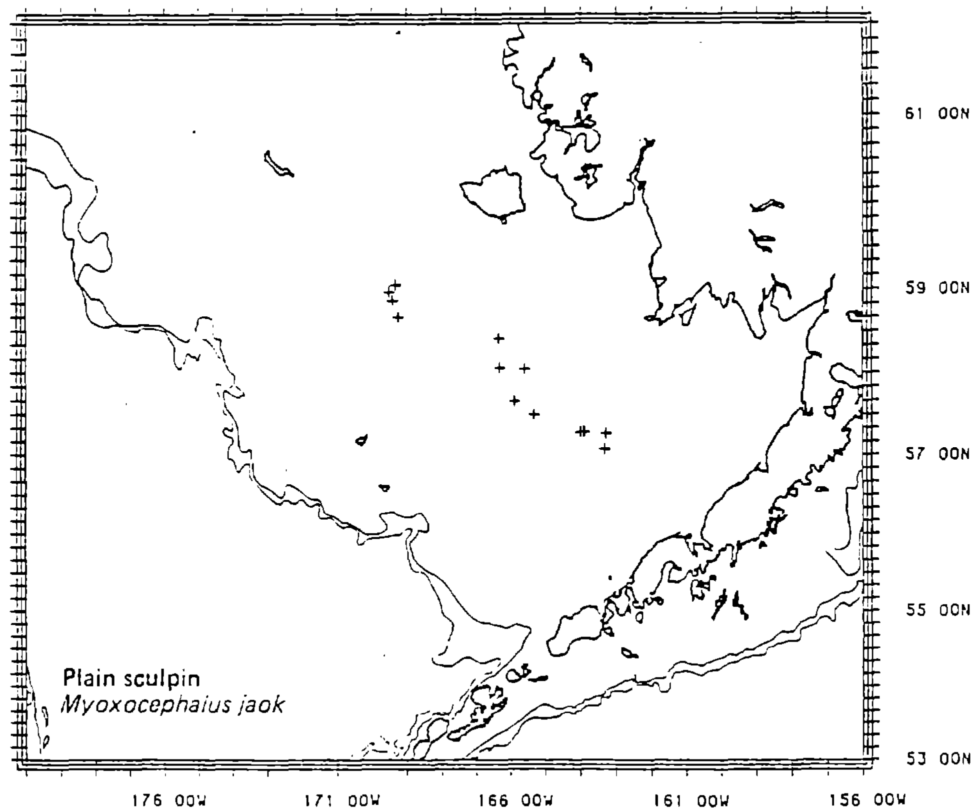
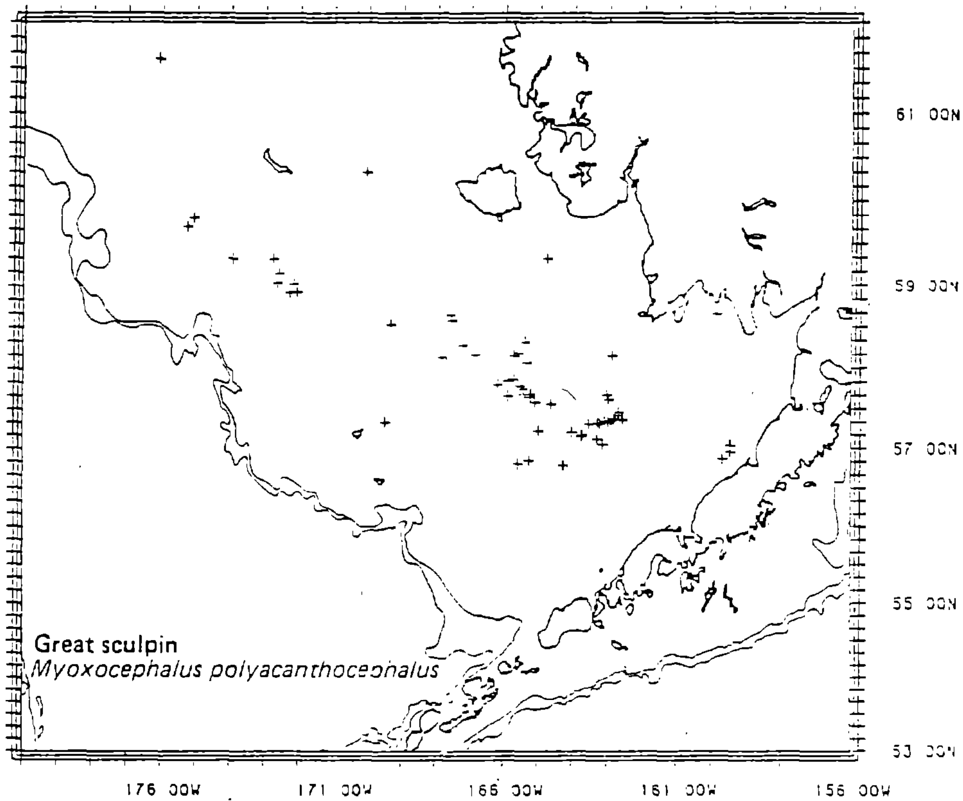


Figure 4.--Locations where stomach scan collections of yellow Irish lord were taken.

Figure 5.--Locations where stomach scan collections of plain sculpin were taken.



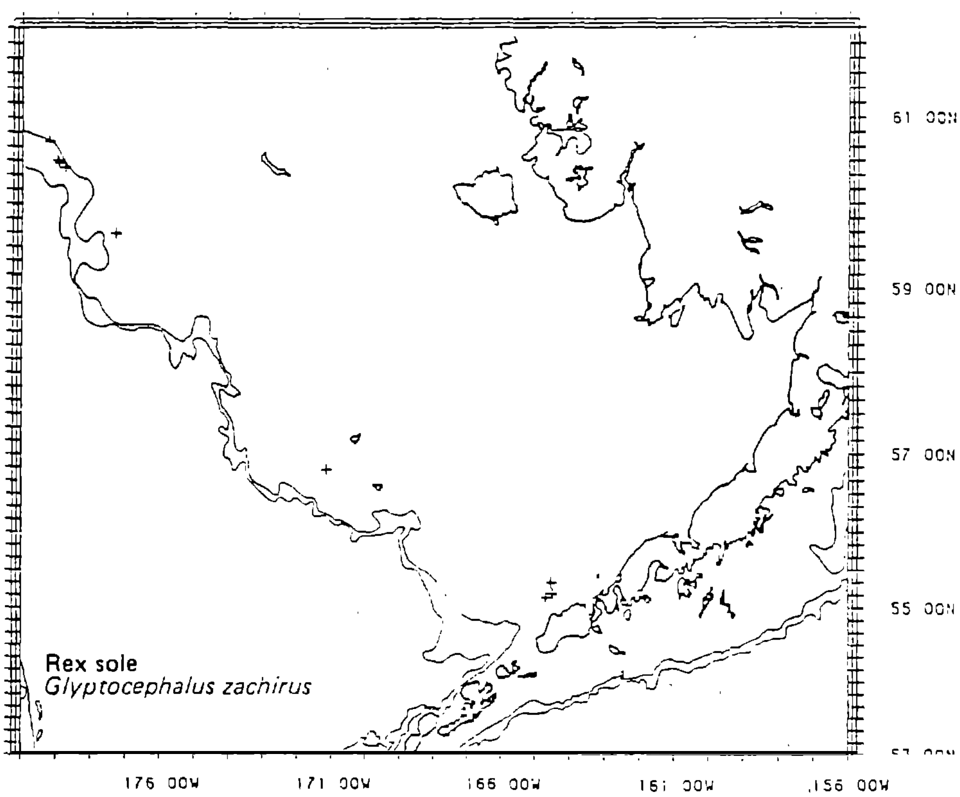
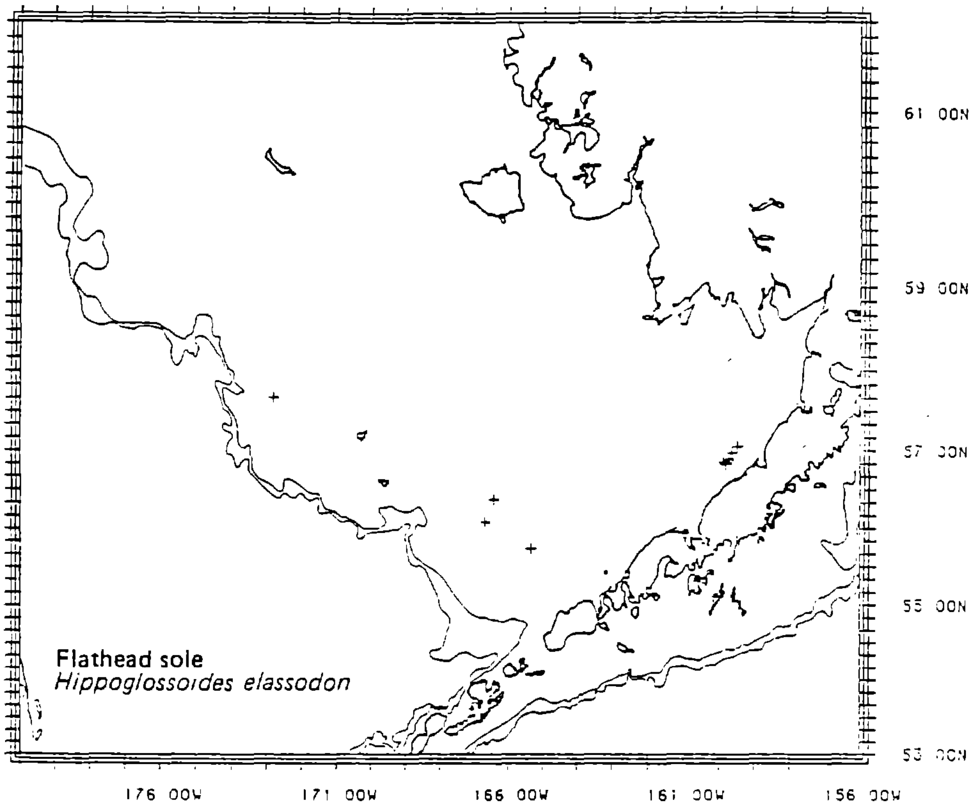


Figure 6. -:Locations where stomach scan collections of great sculpin were taken.

Figure 7. --Location where stomach Scan collections of rex sole were taken.



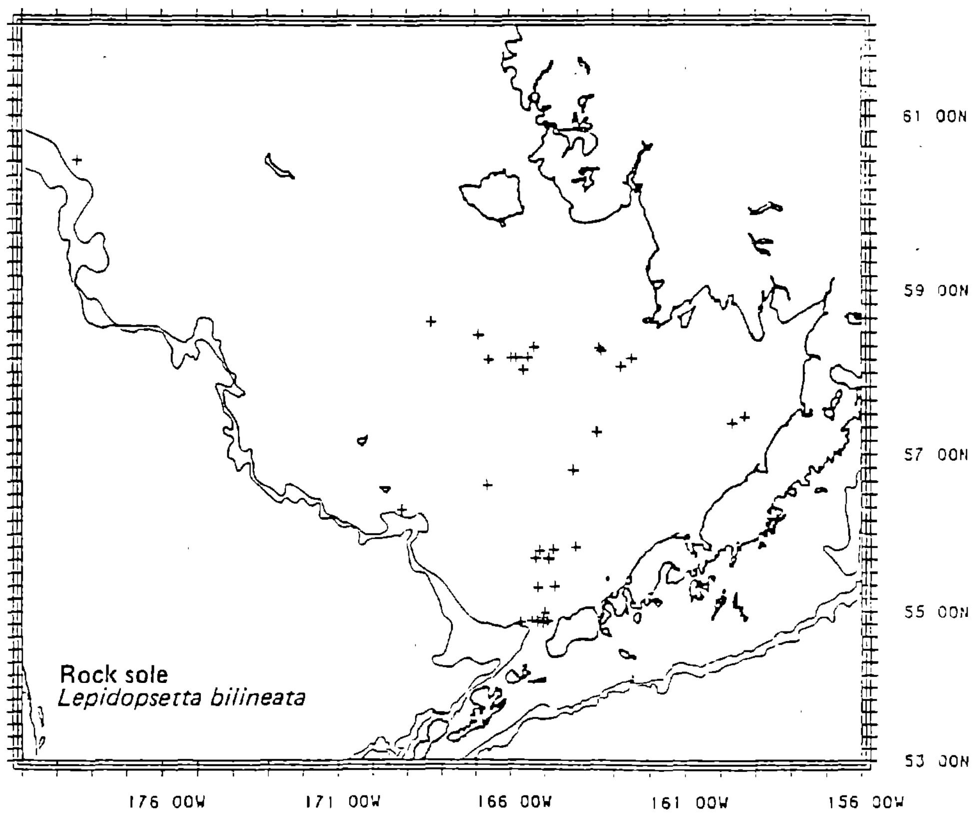
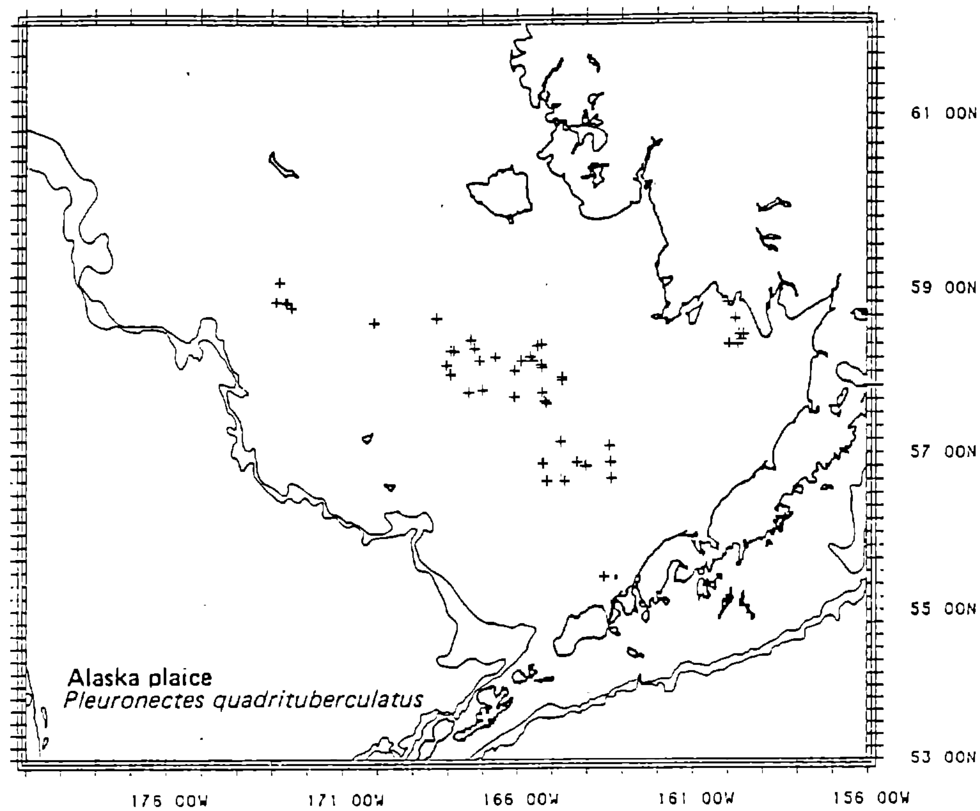


Figure 8.--Locations where stomach scan collections of flathead sole were taken.

Figure, 9.--Locations where stomach scan collections of rock sole were taken.



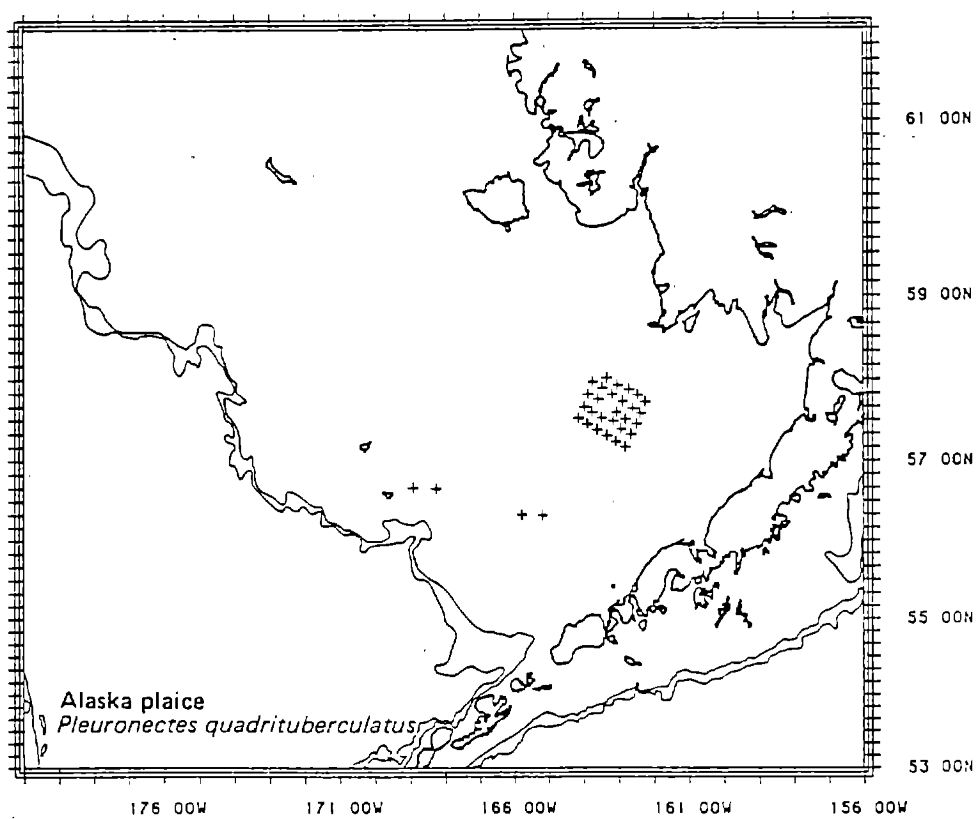


Figure 10a.--Locations where stomach scan collections of Alaska plaice were taken.

Figure 10b.--Locations where Alaska plaice stomachs were taken for detailed laboratory analysis.

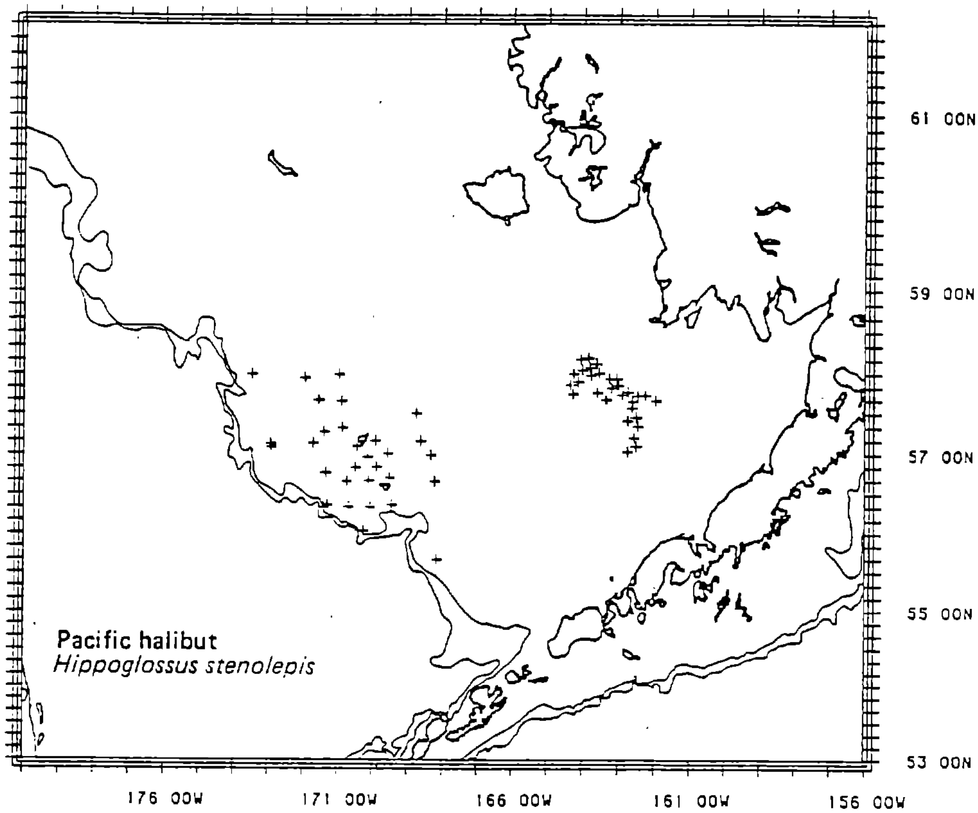


Figure 11.--Locations where Pacific halibut stomachs were taken for detailed laboratory analysis.

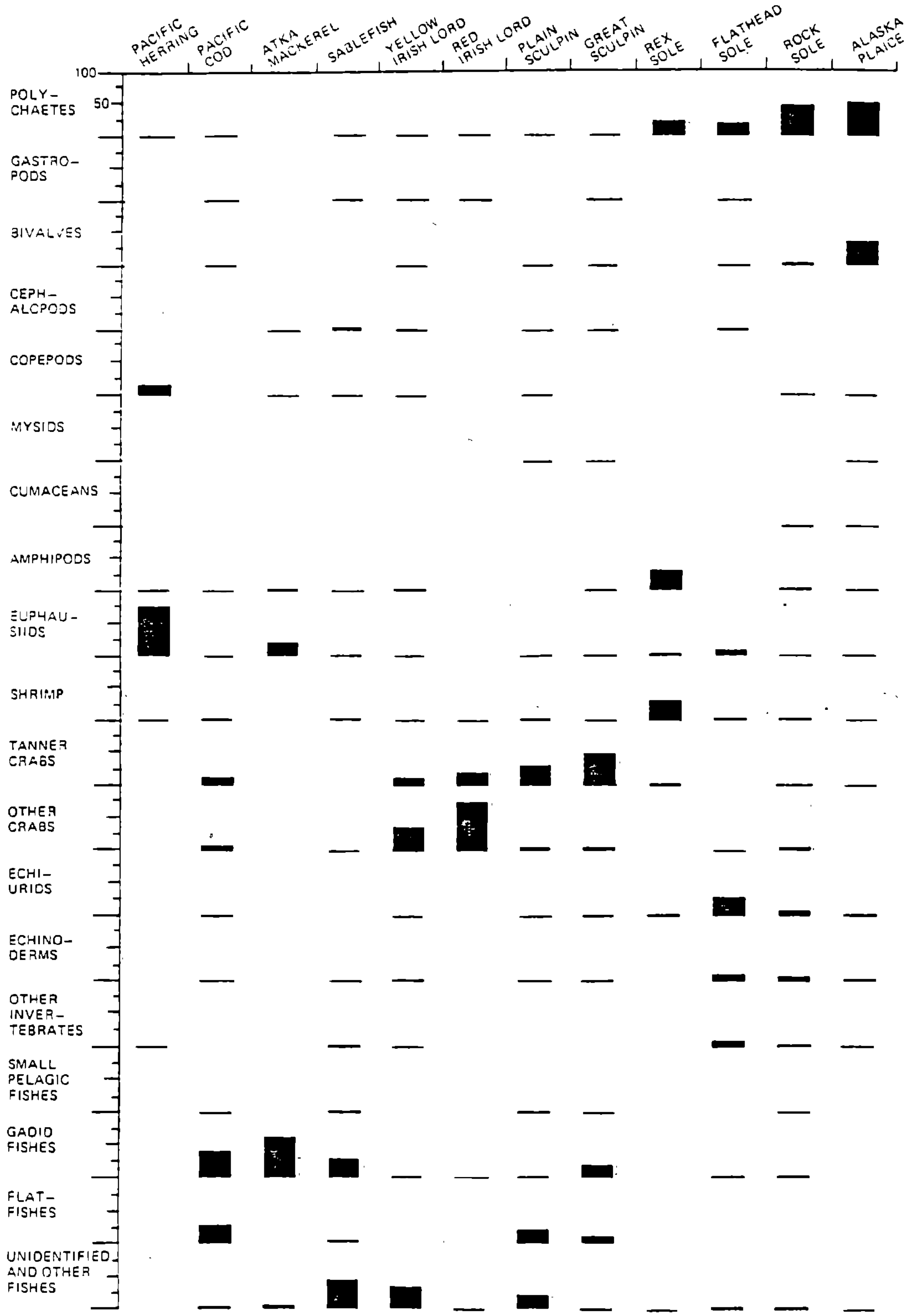


Figure 12. --Utilization of major prey categories by predators for which 60 or more stomachs containing food were examined. Height of bars corresponds to percent of total weight.

DIET OVERLAP

	PACIFIC HERRING	PACIFIC COD	ATKA MACKEREL	SABLEFISH	YELLOW IRISH LORD	RED IRISH LORD	PLAIN SCULPIN	GREAT SCULPIN	REX SOLE	FLATHEAD SOLE	ROCK SOLE	ALASKA PLAICE
PACIFIC HERRING												
PACIFIC COD	1											
ATKA MACKEREL	26	47										
SABLEFISH	3	43	41									
YELLOW IRISH LORD	4	33	15	45								
RED IRISH LORD	0	25	2	4	54							
PLAIN SCULPIN	1	55	13	38	50	29						
GREAT SCULPIN	1	60	28	34	29	28	63					
REX SOLE	8	4	9	4	5	2	6	4				
FLATHEAD SOLE	12	12	21	20	17	3	13	11	31			
ROCK SOLE	5	23	13	15	21	8	18	16	34	55		
ALASKA PLAICE	4	3	3	2	9	2	3	4	31	30	66	

0 < 30   30 < 60   60 < 100

Figure 13. --Diet overlap among predators for which 60 or more stomachs containing food were examined. Numbers below the diagonal represents the interspecific overlap values and the shading above the diagonal corresponds to the degree (low, medium, high) of overlap.

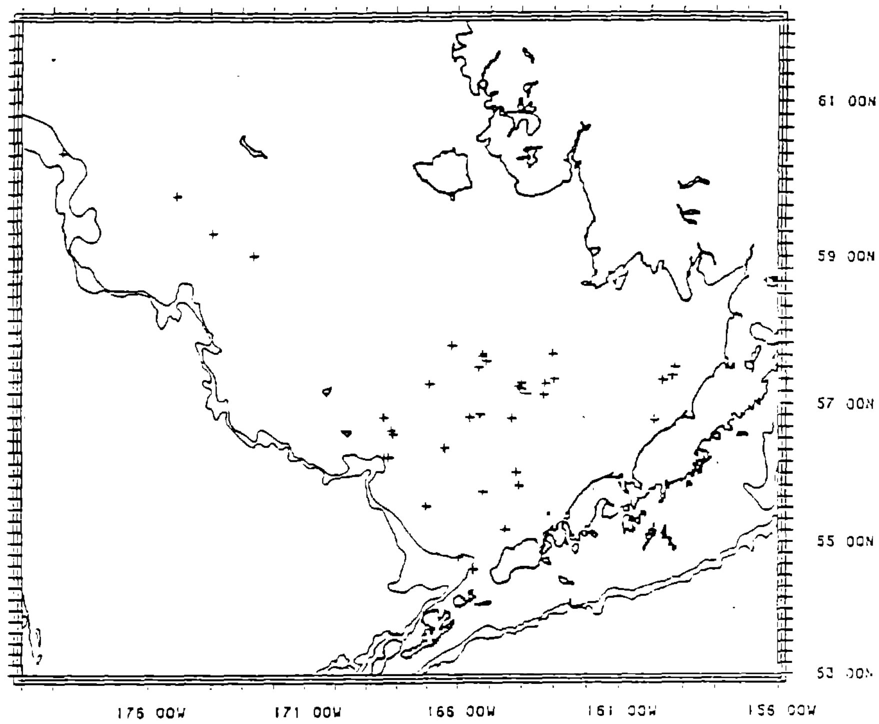


Figure 14.--Locations where fish consuming walleye pollock were taken in stomach scan collections.

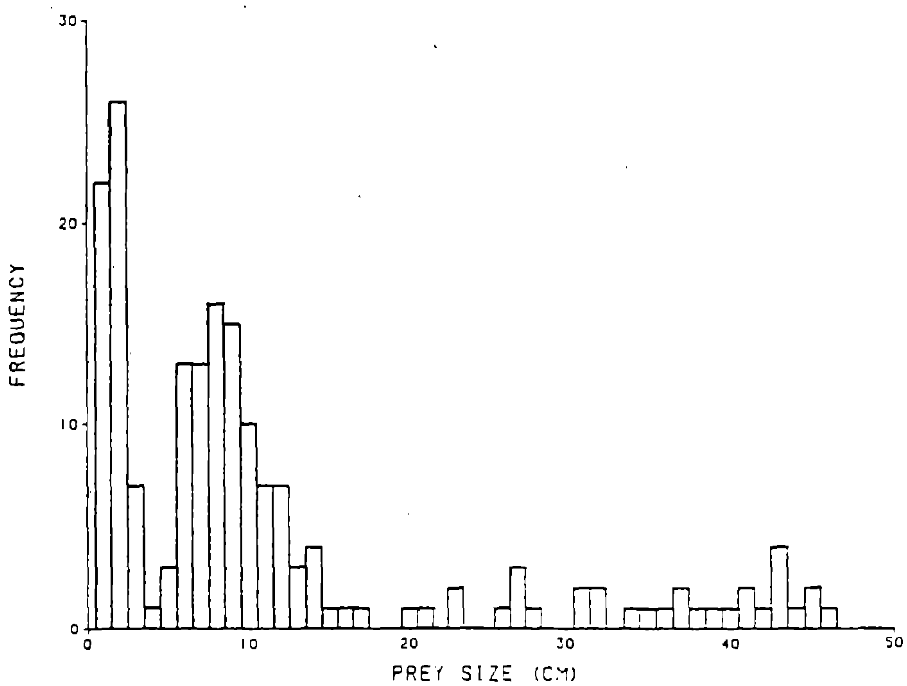


Figure 15.--Length-frequency distribution of measurable walleye pollock found in stomach scans.

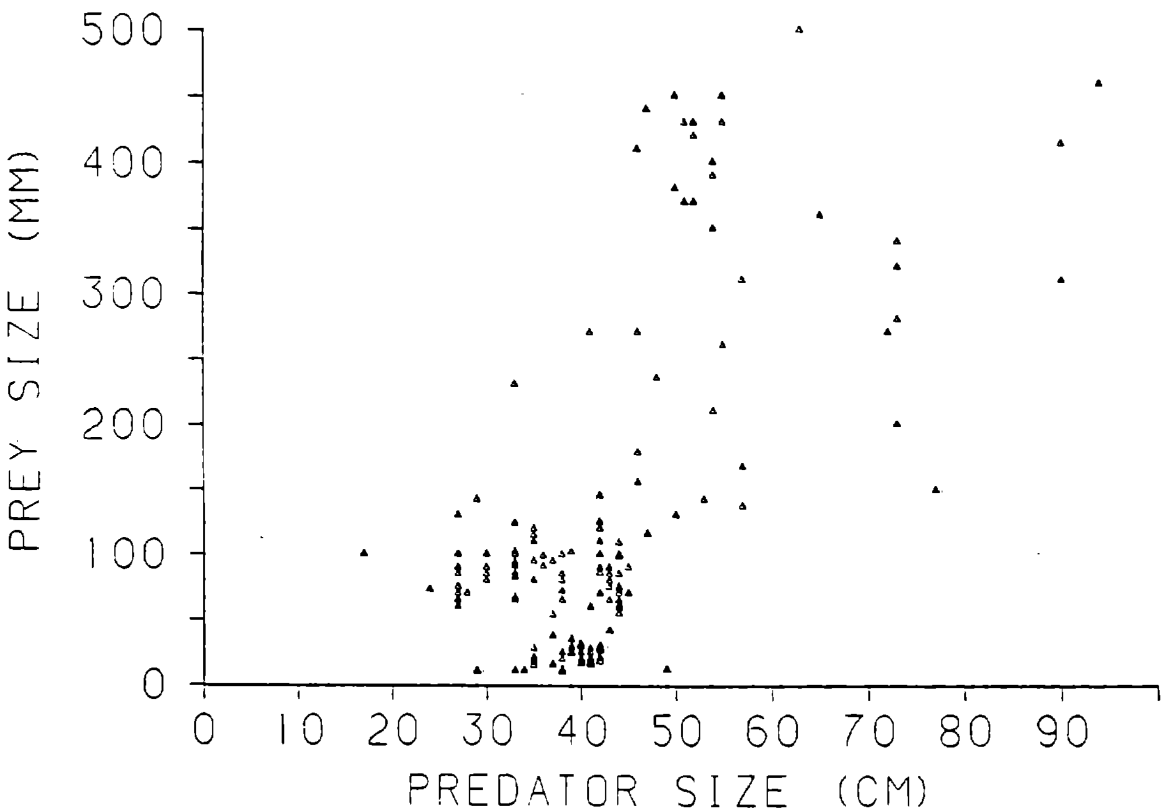


Figure 16.--Relationship between predator lengths and walleye pollock prey lengths in stomach scan collections.

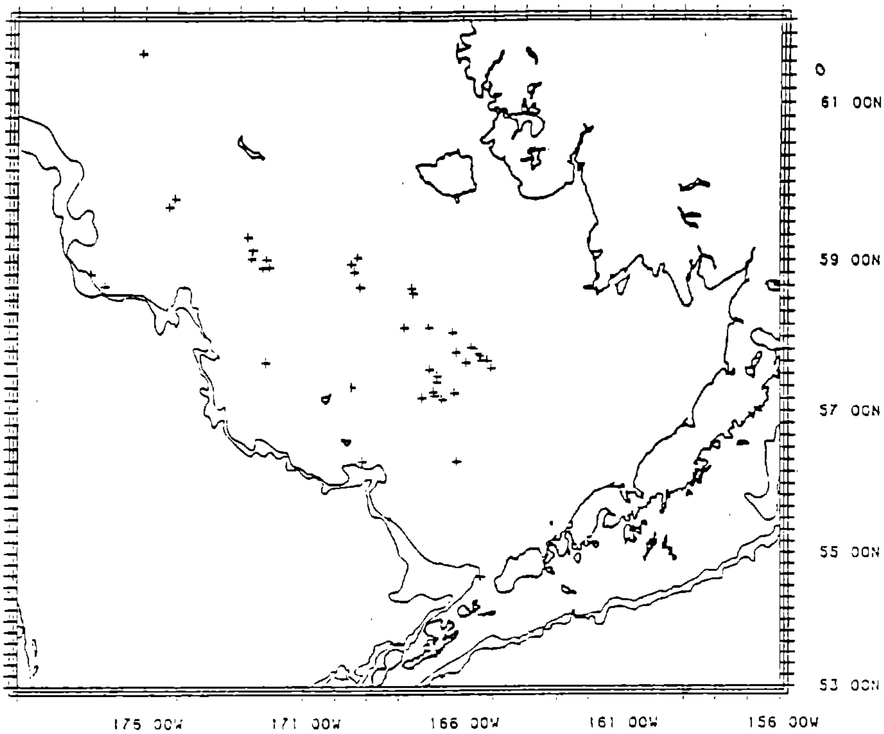


Figure 17. --Locations where fish consuming 2. opilio were taken in stomach scan collections.

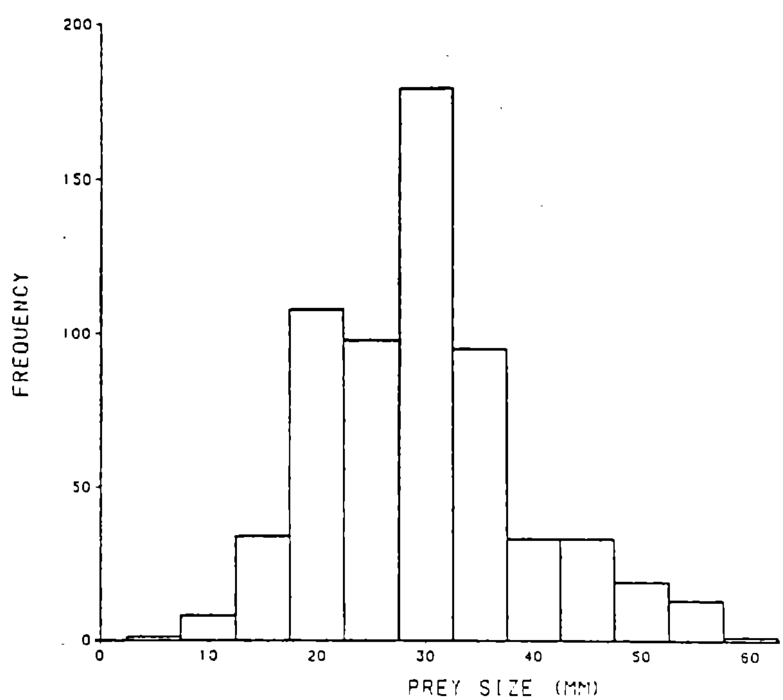


Figure 18. --Length-frequency distribution of measurable C. opilio prey found in stomach scan collections.

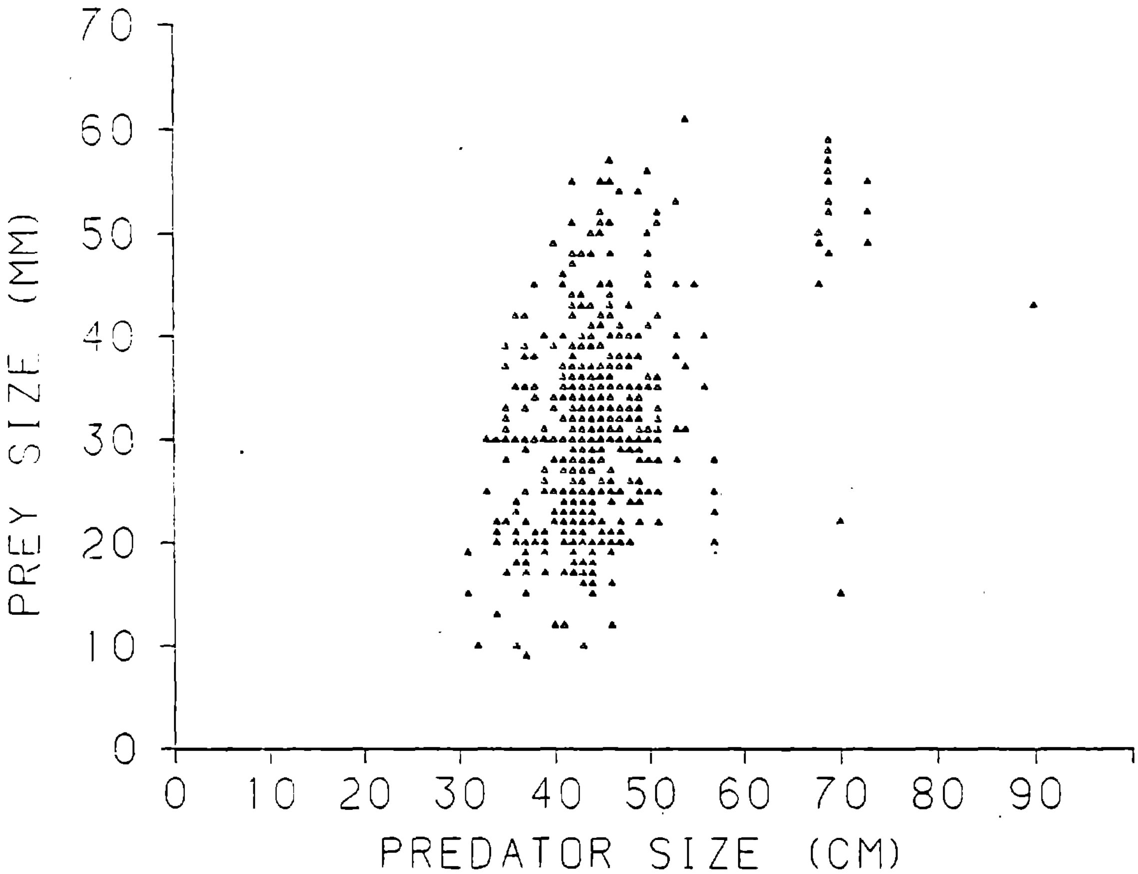


Figure 19.--Relationship between predator lengths and C. opilio prey lengths in stomach scan collections.

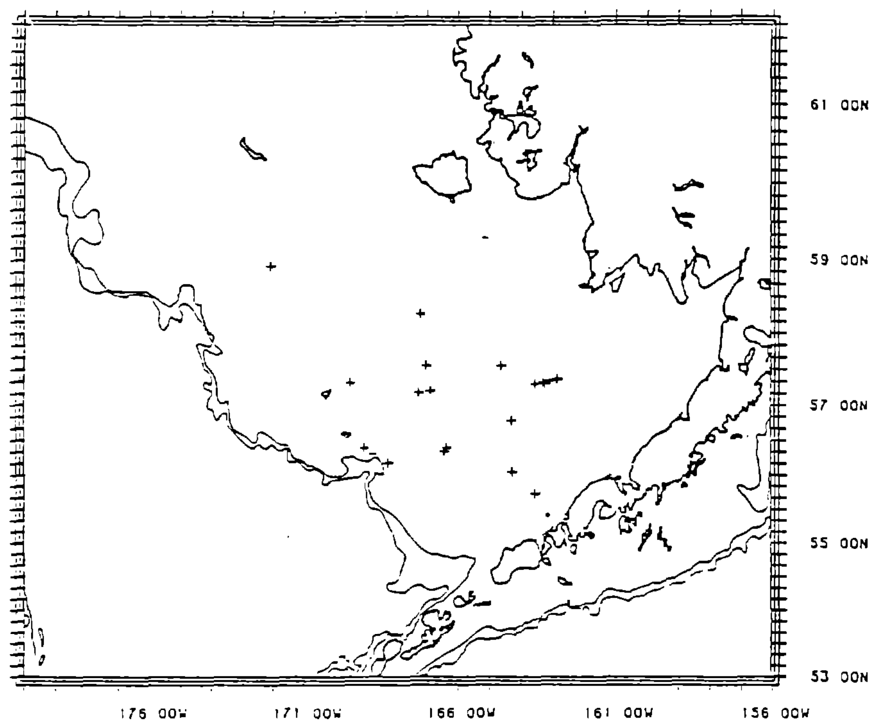


Figure 20. --Locations where fish consuming C. bairdi were taken in stomach scan collections.

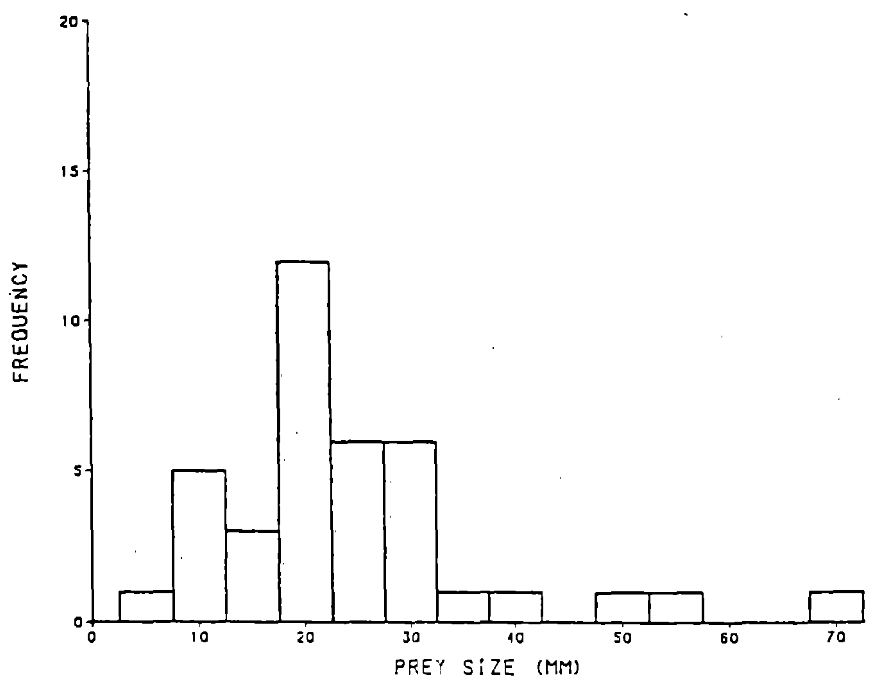


Figure 21. --Length-frequency distribution of measurable C. bairdi prey found in stomach scan collections.

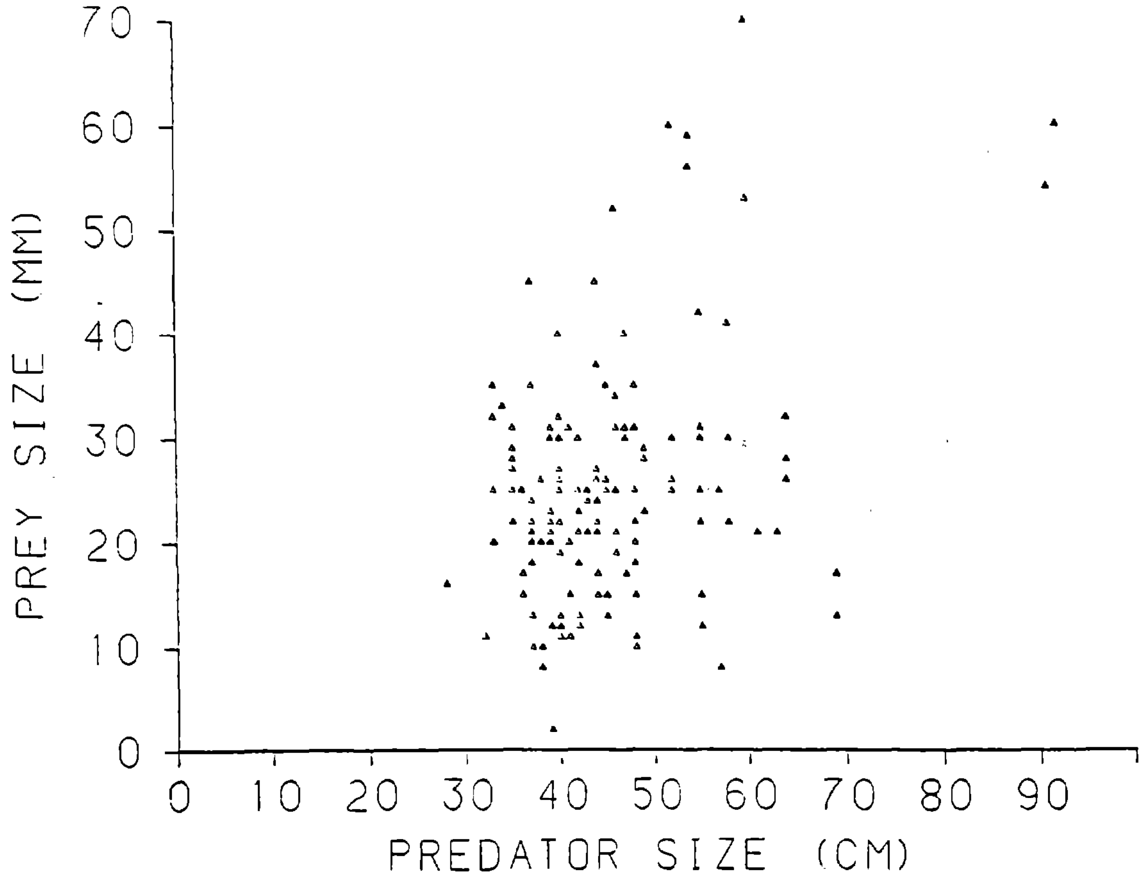


Figure 22.--Relationship between predator lengths and C. bairdi prey lengths in stomach scan collections.